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The Medical Clinics of Chicago

MARCH, 1917

VOLUME 2—NUMBER 5

411882
4.6.43

PHILADELPHIA AND LONDON

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PUBLISHED BI-MONTHLY (SIX NUMBERS A YEAR), BY W. B. SAUNDERS COMPANY, WEST WASHINGTON SQUARE, PHILADELPHIA.

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The
Medical Clinics of Chicago

VOLUME 2 NUMBER 5

CLINIC OF DR. FREDERICK TICE

COOK COUNTY HOSPITAL

ANAPHYLAXIS

Definition; Experimental Basis; Effects of Parenteral Injection of Foreign Protein. Alimentary Type of Anaphylaxis Due to Protein Ingestion; Foreign Proteins as Etiologic Factors in Disease. Clinical Manifestations and Therapeutic Considerations. Intravenous Injection of Typhoid Vaccine in the Treatment of Arthritis and Typhoid Fever.

December 18, 1916.

BECAUSE of its great importance clinically and therapeutically it is proposed to briefly indicate some of the phenomena associated with the condition designated as anaphylaxis, hypersusceptibility, or supersensitiveness, and then present a few illustrative cases.

What is understood by the term "anaphylaxis"? According to the definition of Friedman, "We speak of anaphylaxis when the organism, in consequence of a previous treatment with an antigen, after a period of incubation becomes hypersensitive to the same or to a closely related substance, and when this condition can be passively transferred to fresh animals by the serum or organ extracts of the sensitized animal."

The term "anaphylaxis" was coined by Richet to indicate a condition the opposite of prophylaxis. As now interpreted it is a misnomer, for immunity and anaphylaxis are really only different manifestations of one and the same process. Protein hypersusceptibility or supersensitiveness are really more descriptive and

accurate terms than anaphylaxis, although the latter is well established and generally used.

How is anaphylaxis or hypersusceptibility produced? Some of the knowledge of this condition as obtained from animal experimentation will be briefly presented.

When a foreign protein is introduced either subcutaneously, intravenously, intraspinously, intraperitoneally, or by some other route into an organism, various effects will be produced. If an animal is given a foreign protein, for instance, normal serum, in one of the methods indicated, no appreciable effect is usually produced. If after an interval of six to fourteen days the experiment is repeated the animal immediately becomes ill and presents definite symptoms, depending on the amount of serum used and how it was given. If a small amount is given subcutaneously the resulting disturbances may be slight and transitory, the animal soon recovers, but if a sufficient amount be given intravenously or intraperitoneally, death occurs, generally within a few minutes. This condition resulting from the second injection is designated as active anaphylaxis. For the production of this condition a certain length of time or incubation period must elapse between the initial, or preparatory, and the second, or exciting, injection. During this time, following the initial injection of the foreign protein, the antigen, there is produced one or more antibodies, best designated as the sensitizer. According to von Pirquet it is the union of the antibodies with the antigen which produces the symptoms of serum disease. It has not been definitely determined whether this union takes place in the blood, in the body tissues, or perhaps in both. Abundant evidence, experimental and clinical, indicates that the production of anaphylaxis depends not on a simple union of antigen and antibody, but on a more complex action.

Numerous observers have demonstrated that certain products of protein digestion are quite capable, when injected, of producing symptoms analogous to those of anaphylaxis. This naturally suggested the presence and influence of a ferment in the production of anaphylaxis due to a foreign protein. According to this view, when the first foreign protein is introduced there is pro-

duced the antibody or sensitizer which stimulates the body cells to produce a special proteolytic ferment. It is this ferment which rapidly digests the protein in the subsequent injections, liberating toxic substances which produce the hypersusceptibility.

Under normal conditions enteral digestion of protein is so complete that it does not result in the production of toxic substances and resulting disturbances. It is in parenteral digestion, when the protein is introduced into the blood and body tissues, that the toxic portion of the protein molecule is liberated, and, failing to undergo subsequent changes to render it harmless, produces various clinical phenomena. On the basis of an enteral and parenteral digestion of protein an attempt has been made to explain many of the physiologic or pathologic changes.

There can be but little doubt of the important rôle of the parenteral digestion of protein in the clinical manifestation of disease and immunity. A large number of foreign proteins, both animal and vegetable, have been investigated and conclusively demonstrated experimentally and clinically as the etiologic factors of disease. Modern science has too strongly emphasized the mere presence of some micro-organism as indicating and constituting disease.

Disturbed function, symptoms of disease, depend on and occur only after the breaking down of the protein of the infecting organism and, in some instances, of the body cells. The same process also determines the final outcome in disease; the hypersusceptibility producing immunity or resulting in death. From the standpoint of diagnosis, many of the laboratory and clinical tests are only means of detecting the presence and degree of the hypersusceptibility. Then, finally, the hypersusceptibility to a foreign protein constitutes the essential and fundamental principle in vaccine therapy.

The first case to be presented will illustrate the accidental production of an anaphylaxis of the alimentary type.

Case 1.—The patient, a female aged twenty-five years, by occupation a factory worker, was admitted to the hospital on October 1, 1916.

Present History.—The patient was admitted at 1.30 A. M., with the history of having eaten a fish-dinner about six or seven hours previously. About half an hour after eating she was seized with severe pains and marked tenderness in the epigastrium. A physician was called and a stomach lavage was done. Considerable quantities of food, particularly fish, were removed.

Previous History.—The patient states that about three months ago she had a similar attack following the ingestion of chicken. The history otherwise is negative.

Physical Examination.—Nothing abnormal was found with the exception of epigastric tenderness and areas of hyperemia irregularly distributed over the surface of the body.

The *temperature* on admission was 98.6° F., pulse 84, respirations 24. At no time has the temperature exceeded 99° F.

Oct. 2d: The patient complains of a severe headache, is constantly nauseated, and vomiting at frequent intervals. There is marked tenderness in the epigastrium. She is unable to void urine voluntarily. Over the greater part of the body there is an urticarial eruption accompanied by an intense itching. She complains of stiffness and pain in the joints of the extremities, especially the wrists and knees.

Oct. 3d: Headache, epigastric distress, and lumbar pains are present. The urticarial eruption and itching persist.

Oct. 4th: The patient feels somewhat improved; the itching and burning are not so troublesome, but she still complains of a severe headache and discomfort in the back. She is nauseated on taking any liquids.

Oct. 5th: She has periodic attacks of abdominal cramps, most marked in the lower abdominal region. No nausea or vomiting is present.

Oct. 6th: Abdominal cramps are still present. The bowels have moved voluntarily, but the urinary retention still persists. The headache has practically disappeared. She complains of coldness of the feet and hands.

Oct. 8th: The patient again complains of lumbar discomfort, with stiffness and pains in nearly all the joints; the discomfort and pain is made worse by movement. Urinary retention has

disappeared. There are still some small indistinct areas of urticaria, most marked on the arms and back.

Oct. 9th: Nausea is produced after taking solid food. Some difficulty in urination is present and there is slight headache.

Oct. 11th: The general condition is much improved, but she still complains of headache, with some lumbar and abdominal discomfort. She is no longer nauseated or vomiting. The itching erythema and urticaria have practically disappeared.

Laboratory Findings.—The first urinalysis, made the night she entered, gave a specific gravity of 1020, acid reaction, no albumin or sugar, and was negative microscopically. A urinalysis twenty-four hours later gave a specific gravity of 1040, no albumin or sugar, and microscopically red blood-cells were present. Daily analyses were negative until the morning of the 7th, when albumin was present, with a few hyalin casts and red blood-corpuscles. These findings persisted for three days, when the urine again became normal and has remained so up to the present time.

Blood Examination.—Several blood examinations made between the 1st and 10th gave a hemoglobin percentage between 70 and 80, erythrocytes between 3,950,000 and 4,200,000. The leukocytes varied daily between 10,600 and 15,000. On the morning of the 10th the leukocyte count was 8950. Several differentials revealed nothing abnormal; blood-cultures were negative. Gastric tests and stool examinations were negative.

From the previous history, clinical symptoms, and physical findings it was evident that there was some dietetic disturbance. The diagnosis was specially concerned with a food poisoning or an anaphylaxis of an alimentary type. Gastric disturbances may result as the effect of products of decomposition, especially including the various articles of diet preserved by means of refrigeration or canning. Probably many of the gastro-intestinal disturbances associated with food poisoning result from the effect of toxins or various decomposition products.

Another possible effect is the production of an alimentary type of an anaphylaxis due to the ingestion of various proteins. So far as the patient can inform us, the chicken eaten some months ago as well as the recently consumed fish were perfectly fresh.

In the present attack the early appearance of gastro-intestinal disturbance, followed by cutaneous erythema, an urticaria, and later articular manifestations, strongly suggest and justify a diagnosis of alimentary anaphylaxis.

Rosenow and Anderson were the first to direct attention to the possibility of inducing an anaphylaxis by alimentary ingestion. Instances of this type are fairly numerous, and it is only necessary to refer to the cases due to ingesting certain articles of food, especially eggs, milk, certain kinds of fish, and strawberries.

Alimentary anaphylaxis may be explained on the ground that the products of normal digestion enter the circulation of an individual previously sensitized by some other means, as disease or protein injections; or because the enteral digestion is abnormal and the protein only partially or imperfectly prepared for absorption. It is even possible in some instances that both conditions are present.

Of special interest clinically are those cases due to a diet consisting in part or entirely of milk or eggs. Not a few individuals are unable to eat eggs without symptoms of intoxication. A familiar example is the egg asthma occasionally encountered. Much of the difficulty in the artificial feeding of infants is due to the hypersensitiveness induced by cows' milk. Experimentally anaphylaxis has been produced in the rabbit and dog by rectal injections of white of egg, and it is a practical question how often this may occur in the rectal feeding of patients when the nutritive enema contains a foreign protein.

When an alimentary anaphylaxis occurs it is usually possible to readily determine the article of food that has caused the disturbance. If there is any doubt, certain diagnostic methods may be of assistance. Either the cutaneous vaccination or the intracutaneous injection of an aqueous solution of the various foods or the pure proteins may be used to test the sensitiveness. This method has also been employed successfully in the infantile eczemas.

The following cases will illustrate the intentional production of anaphylaxis for therapeutic purposes:

Case 2.—A female, aged fifty-two years, a housewife, was admitted to the hospital September 6, 1916.

Present History.—The present attack began one week ago with swelling and pain in the wrists and ankles. The elbows, shoulders, and knees were also involved, but to a less extent. The slightest movement or pressure produced severe pain. The patient believes that she had a fever during the past week.

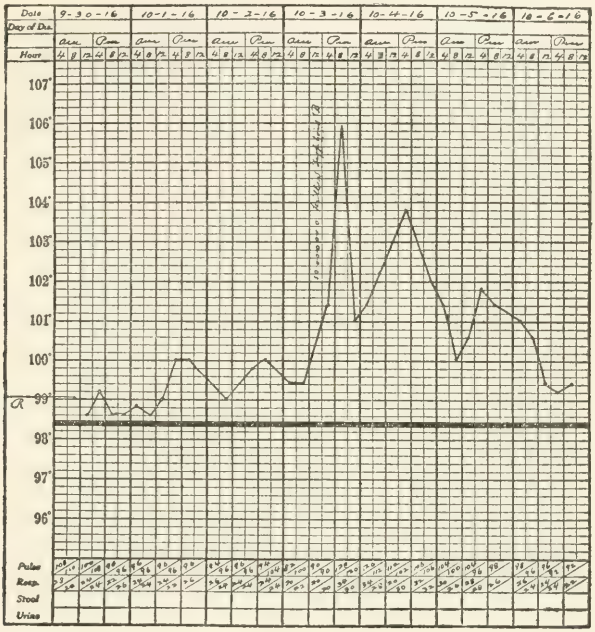

Fig. 131.—Case II. Temperature curve shows sharp elevation and fall following injection of vaccine.

Past History.—She has always been in good health until the present attack. There is no previous history of rheumatism.

Physical Examination.—Reveals signs of a multiple arthritis, involving particularly the joints of the hands and feet. The tonsils are moderately hypertrophied and apparently infected.

x-Ray Findings.—Both hands and feet exhibit changes of a rheumatoid arthritis in the beginning of the deforming stage. The knees show similar changes, although not so pronounced.

The alveolar processes show many abscesses. The sinuses are negative.

Laboratory Findings.—The result of several urinalyses gives an average specific gravity of 1015, an acid reaction, no albumin or sugar. Microscopically, an occasional hyaline cast is found.

Blood Examination.—Hemoglobin 70 per cent., erythrocytes 3,456,000, leukocytes varying from 13,000 to 19,750. The varia-

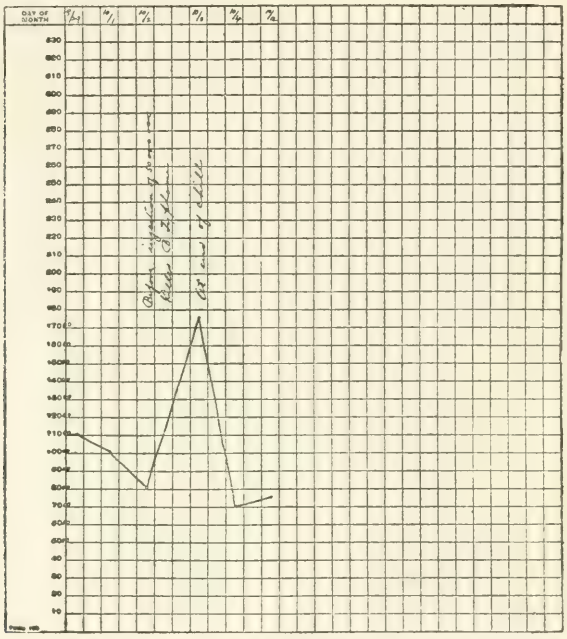

Fig. 132.—Case II. Leukocyte curve, with elevation and fall following injection of vaccine.

tion in the leukocytes is shown in the accompanying chart of the leukocyte curve. Sputum examination was negative. A blood-serum Wassermann was negative.

Diagnosis.—Subacute rheumatoid arthritis; multiple alveolar abscesses; chronic hypertrophic infected tonsils.

Etiologically considered, the articular involvement probably resulted from the alveolar and tonsillar infections. From a therapeutic standpoint, aside from enucleation of the tonsils and

local treatment of the multiple alveolar abscesses, the patient received sodium salicylate and sodium bicarbonate, of each 15 grains, every four hours. Little or no improvement was manifest either symptomatically or objectively. After continuing the salicylate and bicarbonate over a period of three weeks, an intravenous injection of 10,000,000 killed typhoid bacilli was given, but without any manifest reaction. The following day the intravenous injection was repeated, using 50,000,000 of the same vaccine. About two hours after the injection the temperature had risen a little over one degree. No discomfort of any kind was present. Half an hour later there was a very severe chill, the patient complaining of being cold, the entire body shaking, and accompanied by headache. The chill continued severe for approximately twenty minutes and was then followed by a profuse, drenching sweat. At the height of the chill the temperature reached 105.8° F. per rectum. Following the sweat and a sponge-bath the temperature fell to 101° F., and subsequently rose, as indicated in the temperature curve. Four days after the injection the temperature became normal, the discomfort in the joints as well as the local manifestations became much improved, and the patient was able to be up and about. This condition has continued up to the present.

Case 3.—A female, aged twenty-seven years, was admitted to the hospital September 29, 1916.

Present History.—The patient says she had been sick for four days. The illness began with slight recurrent chills and fever, severe headache, epistaxis, sweats, discomfort in the abdomen, constipation, frequent micturition, a slight nausea, anorexia, weakness, and a cough.

Physical examination revealed the presence of a pyrexia of 103° F., a pulse of 116, and respirations 40 per minute. The spleen was palpable and there were rose spots on the abdomen.

Laboratory Findings.—The urinalysis was negative. Preliminary blood examination—hemoglobin 70 per cent.; erythrocytes 3,124,000; leukocytes 2900. Blood-cultures taken at that time were subsequently reported positive for typhoid bacilli. A Widal at this time was negative. Two days later a Widal in a

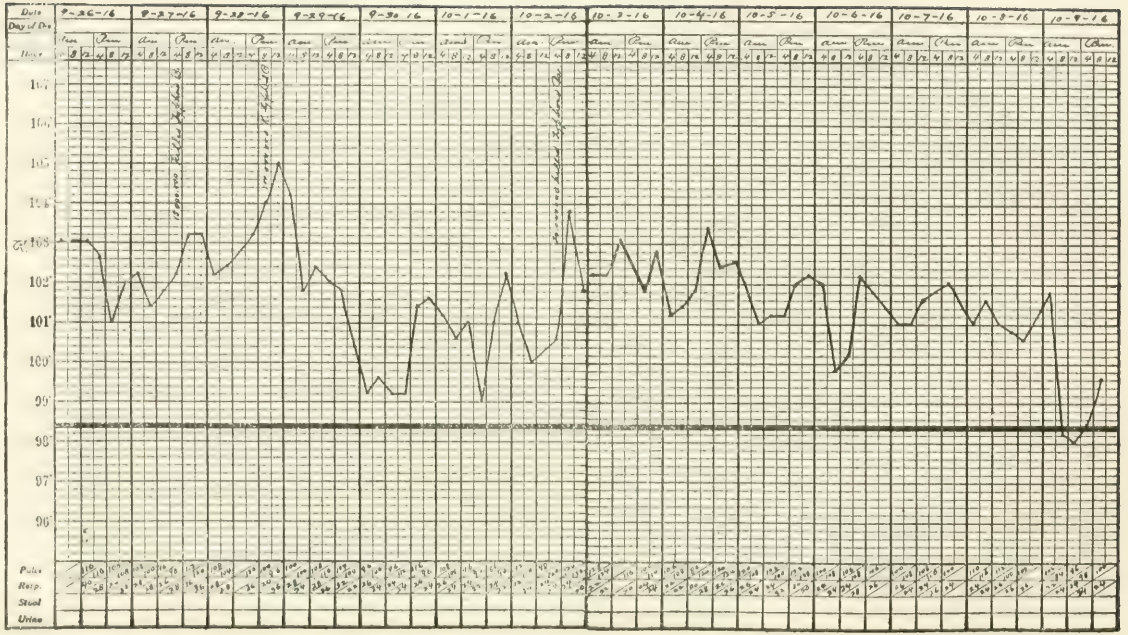

Fig. 133.—Case III. Temperature curve shows influence of second injection of vaccine, but practically none after the third.

dilution of 1 : 80 was positive; the blood-serum Wassermann was negative.

Diagnosis.—Typhoid fever. In addition to the hydrotherapy and dietetic treatment an intravenous injection of 15,000,000 killed typhoid bacilli was given on September 27th. Two hours later there was a rise in the temperature of one degree, unaccompanied by a chill or sweating. The following day another intravenous injection was given of 100,000,000 killed bacilli. In an

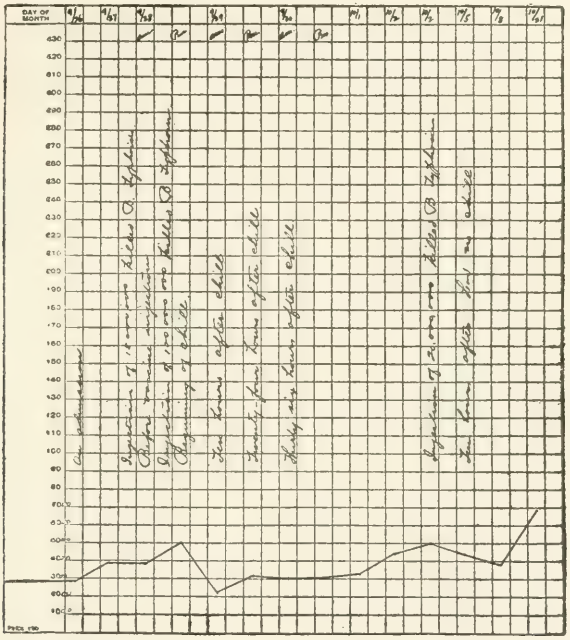

Fig. 134.—Case III. Leukocyte curve but slightly changed by vaccine injections.

hour and three-quarters there was a marked chill, accompanied by a rise in temperature to 105° F. About three hours later, following a sweat, there was a fall in the temperature and the patient slept for four hours. The temperature curve during the subsequent several days ran a course apparently uninfluenced by the vaccine.

Case 4.—A female, aged twenty-four years, a housewife, was admitted to the hospital November 18, 1916.

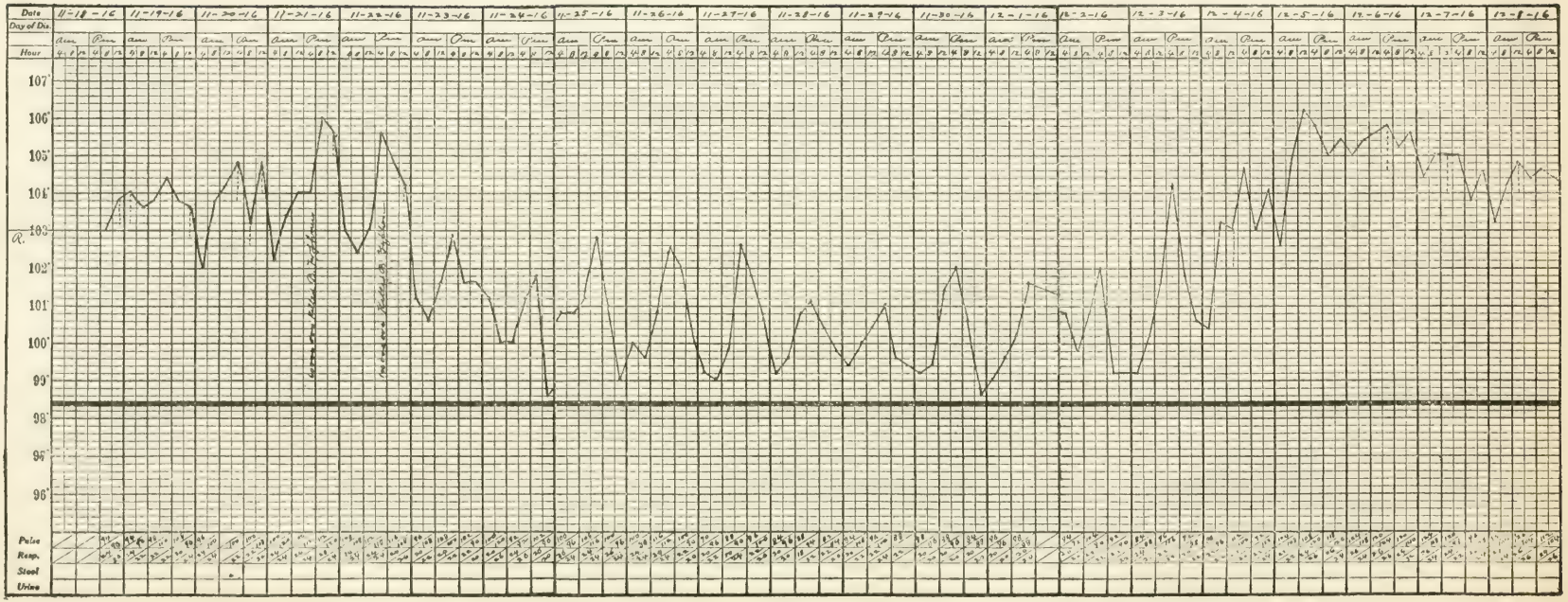

Fig. 135.—Case IV. Temporary improvement, as indicated by temperature curve, with exacerbation.

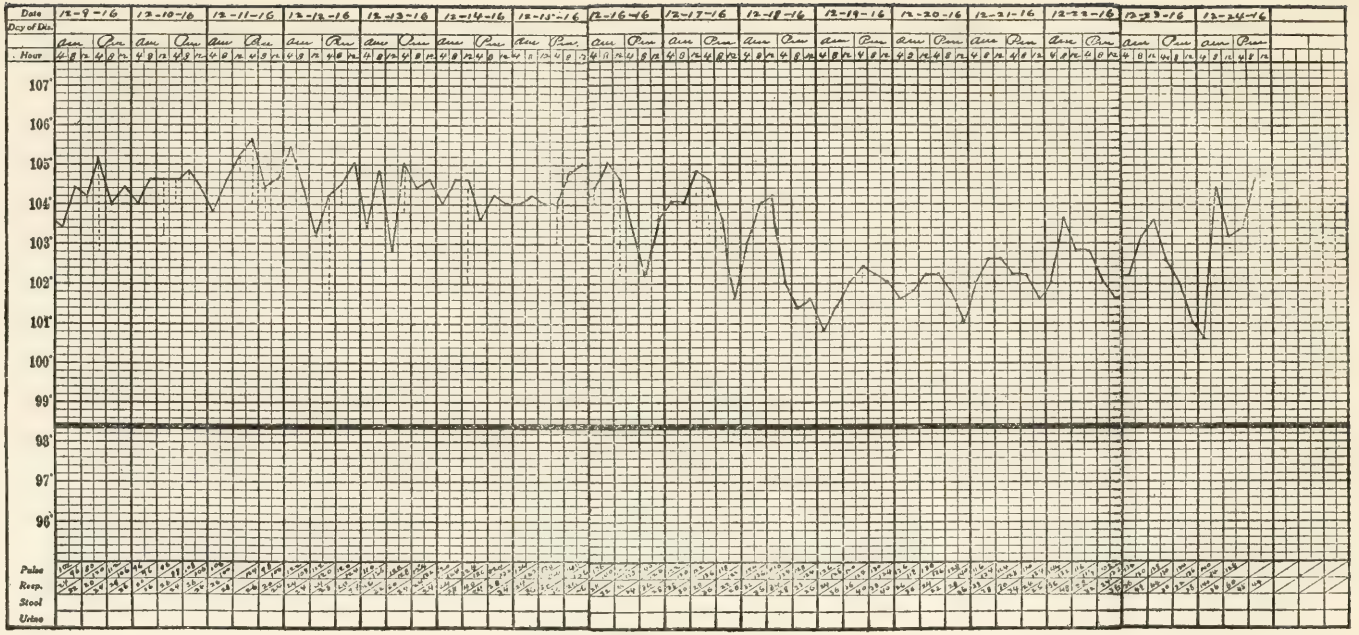

Fig. 136.—Case IV continued.

Present History.—The patient was in the best of health up to two weeks ago, when she was seized with severe headache, dizziness, and a general weakness. One week ago she went to bed because of the extreme weakness, tenderness of the abdomen, and high fever which had been constantly present, being higher in the afternoon. She had diarrhea and a short, dry cough for one week. The appetite was poor.

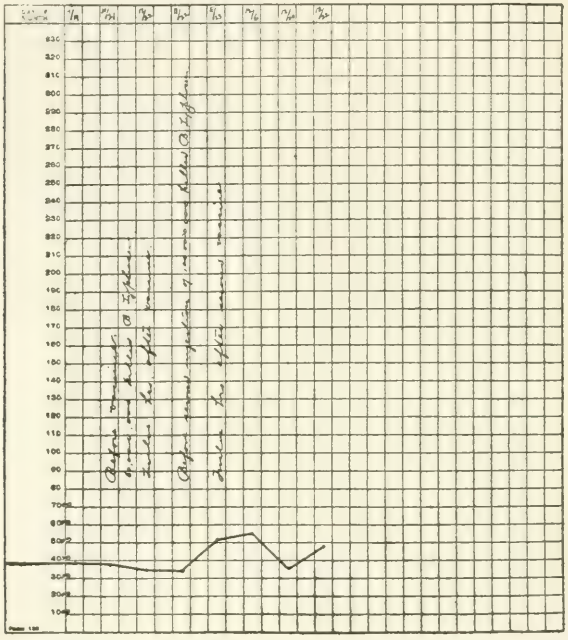

Fig. 137.—Case IV. Only slight leukocytosis following vaccine injections.

Past History.—She has had sore throat and colds occasionally; otherwise always in good health.

Family history is negative. The patient has two children living and well. She denies a venereal infection.

Physical Examination.—The tongue is coated and breath foul; the teeth are in bad condition; the tonsils are enlarged and apparently infected.

Abdominal tenderness is most marked in the left hypochon-

drium. A few rose spots are present on the abdomen. The spleen is palpable, the edge sharp and regular.

The blood-pressure is 120 systolic, 70 diastolic, pulse pressure 40. The pulse is slow in proportion to the temperature, soft and dicrotic in character, regular in time.

Laboratory Findings.—Blood examination: leukocytes, 3950; Widal, gross and microscopic, is strongly positive; cultures negative. Urinalysis: urine acid, specific gravity 1030, albumin, but no casts.

Diagnosis.—Typhoid fever, chronic follicular tonsillitis.

Subsequent Notes.—November 21st: Temperature 102° to 104° F. The patient is moderately toxic. There is an infrequent dry cough and scattered crepitant râles in both lungs. On this date she received 60,000,000 killed typhoid bacilli intravenously, but without producing a reaction.

November 22d: On this date she was given 100,000,000 killed typhoid bacilli intravenously. Two hours later there was a slight chill, with an increase in the temperature which attained its maximum two and a half hours after the injection, when it reached 105.6° F., as indicated in accompanying temperature chart.

The following morning the temperature had dropped to 100.6° F. with a slow pulse and the leukocytes had risen from 3500 to 5200. The spleen was quite large, smooth, and tender; the tongue was heavily coated, the appetite fair and bowels normal.

Case 5.—A female, aged sixteen years, a factory worker, was admitted to the hospital December 5, 1916.

Present History.—On November 29th the patient began having a dull, aching pain in the back of her neck, and on the 30th was unable to get out of bed because of severe backache. During the first four days there were sharp pains in her abdomen. These pains were not constant, but would come and go. Nausea has been present since the onset, and on the second day of the illness she vomited twice. The vomitus was yellow; she noticed no blood, and has not vomited since that time. She complains of loss of appetite and constipation. There is no cough or coryza,

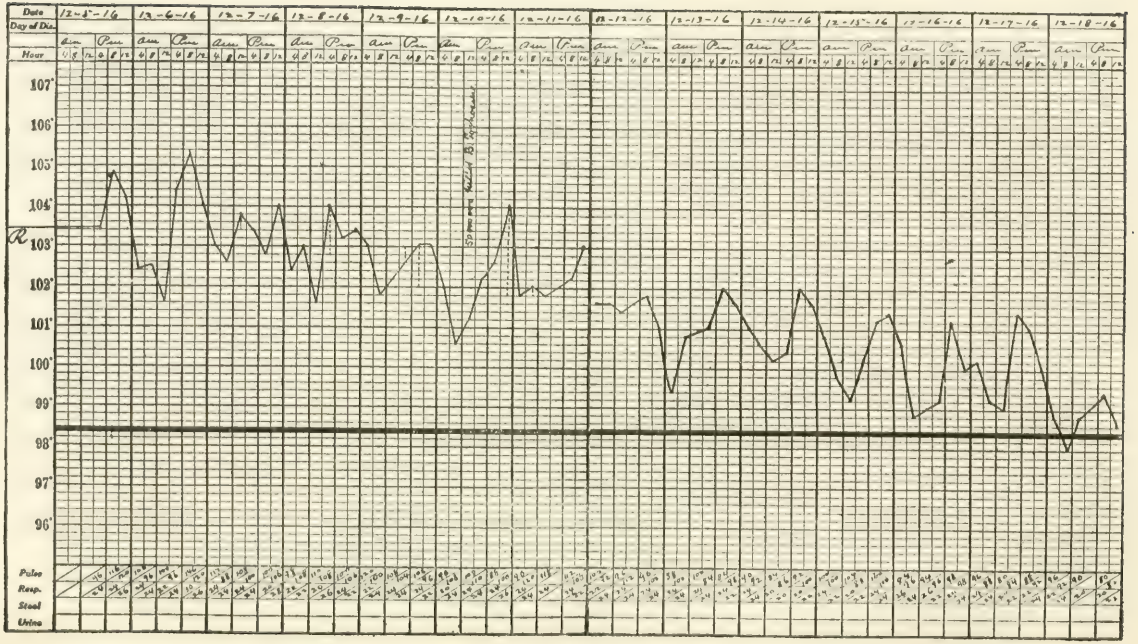

Fig. 138.—Case V. Slight reaction and gradual decline of temperature following vaccine injection.

but she thinks she has had fever since the onset. She felt chilly for three days before she took sick, but had no real chill until after she went to bed, when she had a chill which lasted for ten minutes. Following this she had a profuse sweat.

Past History.—Scarlet fever at six years of age; otherwise negative. She has had much trouble with her teeth.

Family history is negative.

Physical Examination.—The respirations are accelerated and shallow; the pulse is full, rate 96. The face is flushed, the skin hot and dry. There is some evidence of bleeding from the nose. The lips are parched and cracked, the anterior portion of the tongue red and dry; the posterior portion is heavily coated. The tonsils are hypertrophied, the teeth in fair condition. There is a diffuse erythema of the neck and upper portion of the chest.

Rose spots are present over the upper abdomen, chest, and back. Spleen is not palpable.

Laboratory Findings.—Leukocytes 3800; blood-culture and Widal test were both positive on the day of admission. Typhoid bacilli were found in urine and stool cultures. The urine gave a specific gravity of 1016, acid, no albumin or sugar. A few red blood-cells and leukocytes were found. The Wassermann reaction was negative.

The temperature the day of admission was 104.8° F., going down to 101.6° F. the following morning and up to 105.3° F. at 8 P. M. Since then it has ranged from 100.6° to 104° F., as shown in the accompanying curve.

Diagnosis.—Typhoid fever.

Case 6.—A female, aged twenty-three, a clerk, was admitted to the hospital August 31, 1916.

Present History.—Her illness began gradually five days ago with headache and malaise which caused her to go to bed. She had fever at that time, which has gradually increased, and was accompanied by chills and sweats. The following day there was general abdominal soreness, which was most marked just to the right of the umbilicus. There was a loss of appetite and the bowels have been constipated. There has been a slight, non-pro-

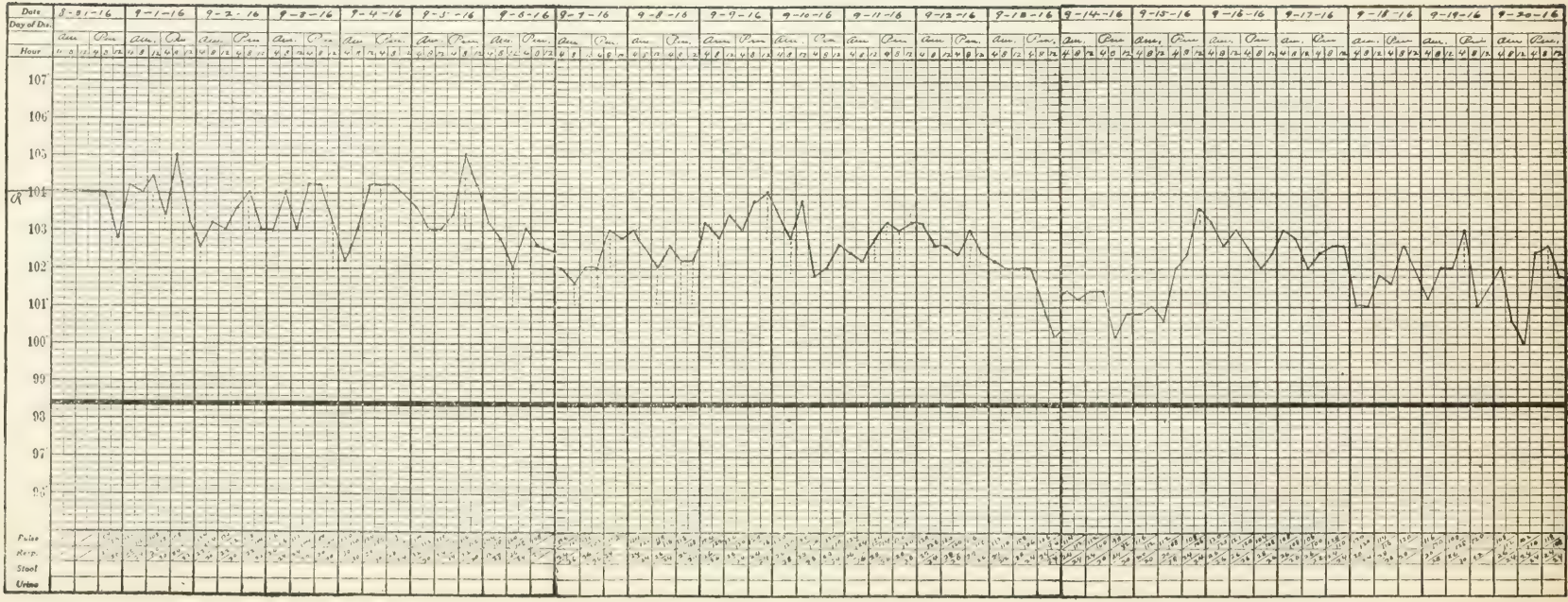

Fig. 139.—Case VI. Temperature curve during course of typhoid; reaction and fall following vaccine injection for cholecystitis.

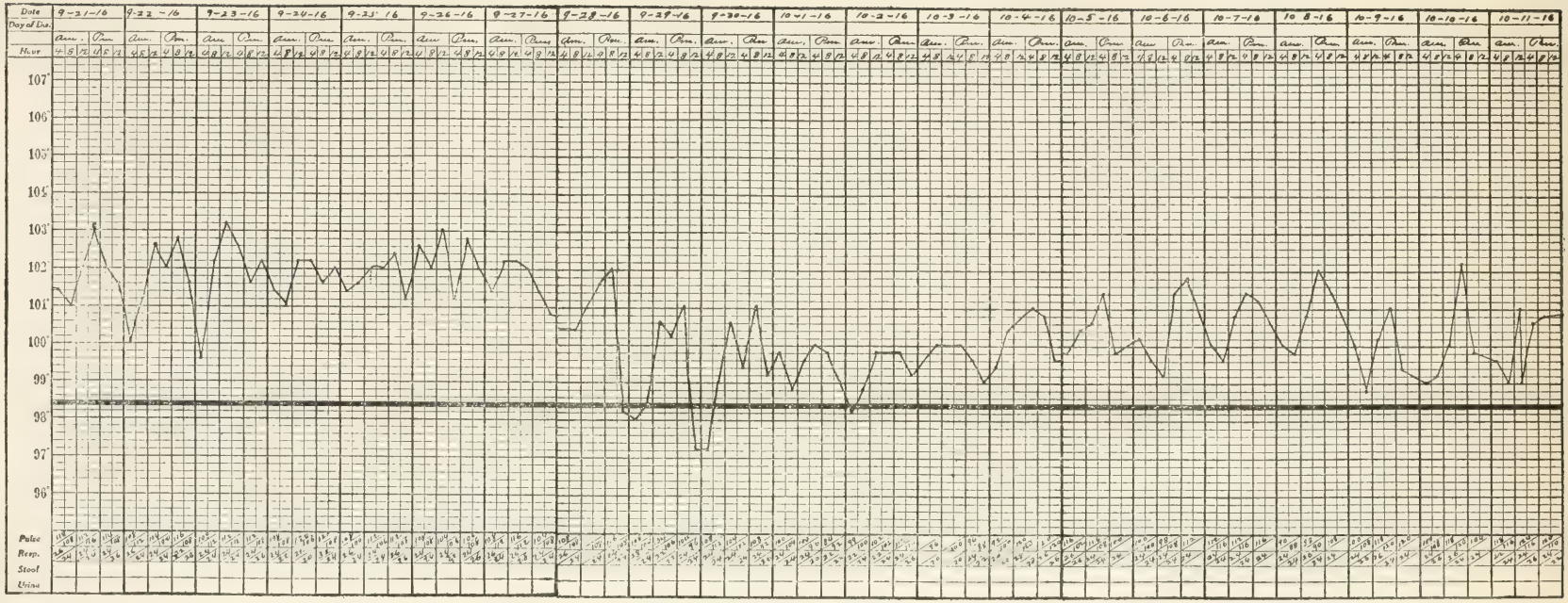

Fig. 140.—Case VI continued.

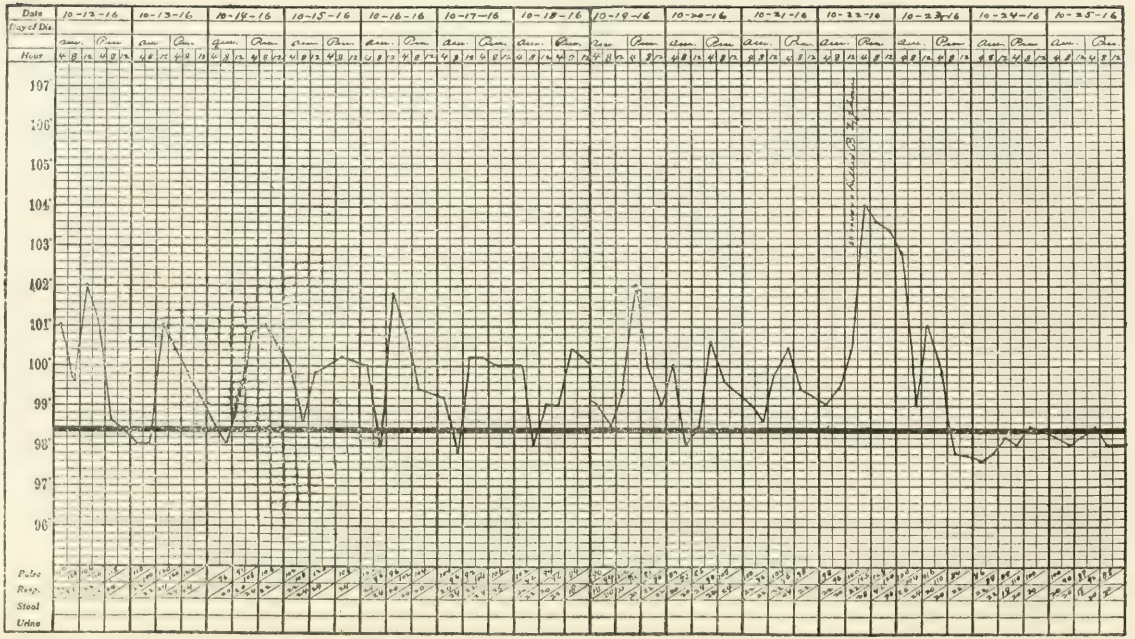

Fig. 141.—Case VI concluded.

ductive cough since the onset. During the last three days nausea and vomiting have also been present.

Past history is negative.

Physical Examination.—Practically negative except for a slight diffuse bronchitis, a few rose spots on the abdomen, and a moderately enlarged spleen.

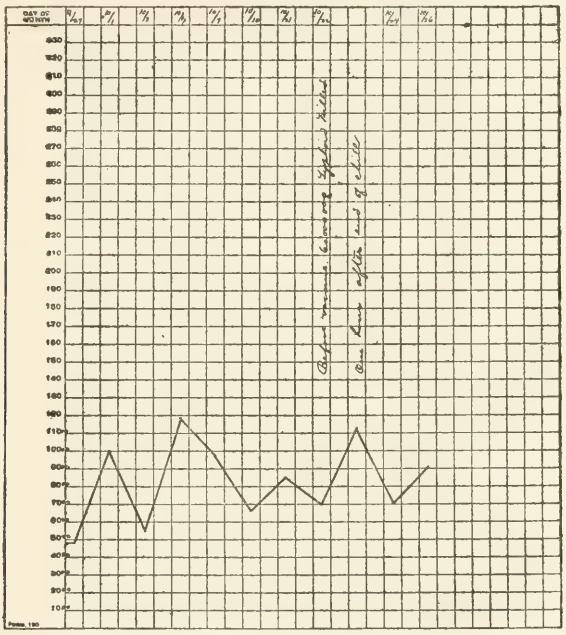

Fig. 142.—Case VI. Leukocyte curve before and following vaccine injection.

Toxic symptoms of a rather marked degree were present when the patient was admitted, and this condition continued during the subsequent three or four weeks.

Laboratory Findings.—Blood examination: hemoglobin 75 per cent., erythrocytes 3,340,000, leukocytes 7100. The Widal test was positive, but blood-cultures were negative. Subsequent leukocyte counts varied between 5600 and 8000. Urinalysis revealed only an albuminuria.

A diagnosis of typhoid was made, and owing to the meningeal manifestations a possible meningitis was suspected. On Sep-

tember 1st a lumbar puncture was made and 10 c.c. of fluid removed which contained four cells to the cubic millimeter, a negative Nonne reaction, and no organisms were found on direct smear or by culture.

During the latter part of the third week the patient suffered from sharp attacks of abdominal pain, the paroxysms lasting for ten or fifteen minutes, the pain being so severe as to cause the patient to cry out. These attacks were accompanied by rigidity and tenderness in the hepatic region. The attacks gradually became less frequent and finally disappeared, but the tenderness in the region of the gall-bladder persisted. A diagnosis of cholecystitis was made.

During the course of the fifth week tenderness and pain were complained of in the lower extremities, most marked in the toes and feet. Slight similar discomfort was also present in the upper extremities. A marked hyperemia was present, involving the feet and toes, accompanied by exquisite tenderness which made movement and examination impossible. Condition was considered due to a toxic multiple neuritis.

After a clinical course of eight weeks with a varying degree of fever, as represented in the accompanying temperature curve, the physical signs indicated the presence of a cholecystitis. Stool and urine cultures at this time revealed the presence of typhoid bacilli.

On September 22d an intravenous injection of typhoid vaccine containing 60,000,000 killed bacilli was given. This was followed in an hour by a chill which lasted for twenty minutes, with an elevation in temperatue, followed by a sweat. During the reaction the patient complained of pain in the region of the gall-bladder; rigidity and tenderness were also present. The leukocyte count before the injection was 7000; following the chill it was 11,500. The next day the count was again 7000. The day following the vaccine and the reaction the temperature fell to normal, and for the succeeding week remained either normal or slightly subnormal. Subsequently a slight afternoon elevation occurred, as shown in the chart. Repeated stool and urine examinations following the vaccine were positive for typhoid

bacilli and remained so for approximately one month. After this period the cultures were negative, those of the urine becoming negative a few days previous to the stools.

The three remaining cases did not receive vaccine therapy. The first one on the tenth day after entering the hospital had a sudden fall in temperature, not due to hemorrhage or perforation, but analogous to the fall after the protein reaction following the intravenous injection of vaccine.

Case 7.—A female, aged sixteen years, a factory worker, was admitted to the hospital August 15, 1916.

Present History.—Five days ago before going to work she drank a bottle of warm milk. In a short time she became ill, quit work, went home at noon, and went to bed. There was headache and general malaise. The following morning she was nauseated and vomited a few times. The bowels were loose and moved repeatedly during the day, and this condition continued throughout the following day. Abdominal pain was present with the diarrhea without any definite localization. The patient believes that she has had a fever since the onset. No chills have occurred.

Previous history and *family history* are negative.

Physical Examination.—When she entered the hospital the rectal temperature was 103° F., and three hours later had reached 105° F. The pulse-rate was 104; respirations 24. At the time of the first examination rose spots were present on the abdomen. The spleen was not palpable until some days later.

Laboratory Findings.—The leukocyte count the day she entered was 6000. A Widal test was negative and remained so until the 20th, five days after admission. The blood, urine, and stool cultures were all positive for typhoid bacilli. Repeated urinalyses revealed a trace of albumin, but negative microscopic findings.

Diagnosis.—Typhoid fever.

On the tenth day, as may be observed in the temperature curve, there was an abrupt fall from 103° to 97.4° F. per rectum. Accompanying this fall the pulse increased from 104 or 108 to 140; the leukocytes were 8550. No abdominal distress, no nausea or

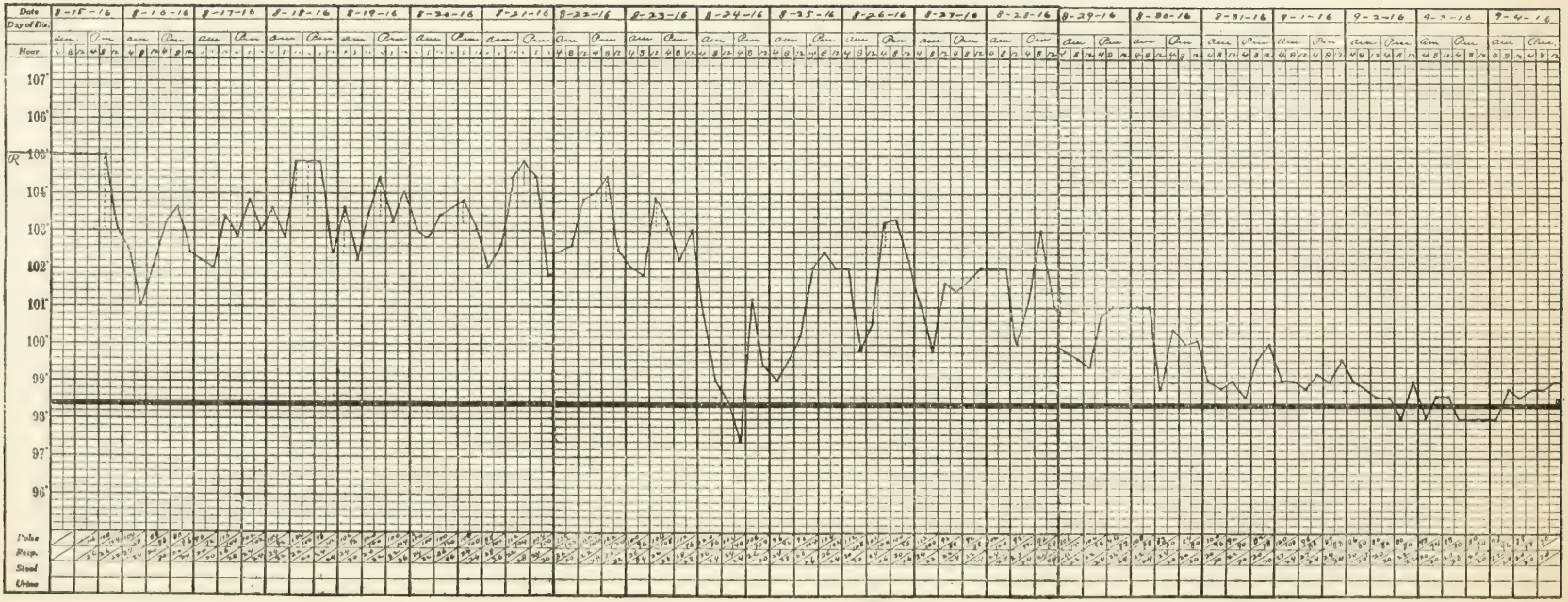

Fig. 143.—Case VII. Temperature curve shows sudden fall to subnormal due to spontaneously developed protein hypersensitiveness.

vomiting accompanied the abrupt fall in temperature. A slight chilliness and some discomfort was manifest. An intestinal hemorrhage was suspected and a possible perforation anticipated. No blood was present in the stools at this time, and repeated examinations failed to reveal the presence of blood during the subsequent course.

The temperature reached the lowest point at 4 P. M., and four hours later had risen to 101.4° F. The following morning at 8 o'clock it was 99° F. and that evening at eight o'clock 102.4° F. Following this period in a few days it reached practically a normal level. This fall in temperature is interpreted as a crisis due to a protein hypersensitiveness or anaphylaxis developed in the course of the disease.

Case 8.—A female, aged fifteen years, a factory worker, was admitted to the hospital November 5, 1916.

Present History.—For four days there was chilliness, headache, fever, and several attacks of epistaxis. A slight cough and constipation were also present. The patient did not feel especially indisposed and remained at work. Three days ago she took to her bed because her condition became worse. She had a severe headache which was aggravated by movement and coughing. At this time she suffered from general weakness and some aching discomfort in the extremities. Recurring chills have been present during the last three days and followed by fever. Yesterday an epistaxis occurred. Pains are present in her abdomen, most marked in the ileocecal region. The appetite has been poor for the last few weeks.

Previous History.—She had measles in childhood and one attack of pneumonia a few years ago.

Physical Examination.—Initial examination was negative. There were no rose spots and the spleen was not palpable. Considerable tenderness in the ileocecal region was present, but unaccompanied by rigidity or a palpable mass.

Laboratory Findings.—Urinalysis was negative. Blood examination the day of admission showed hemoglobin 90 per cent., erythrocytes 4,450,000, leukocytes 8500. Two days later the leukocyte count was 6800. A blood-culture was negative. The

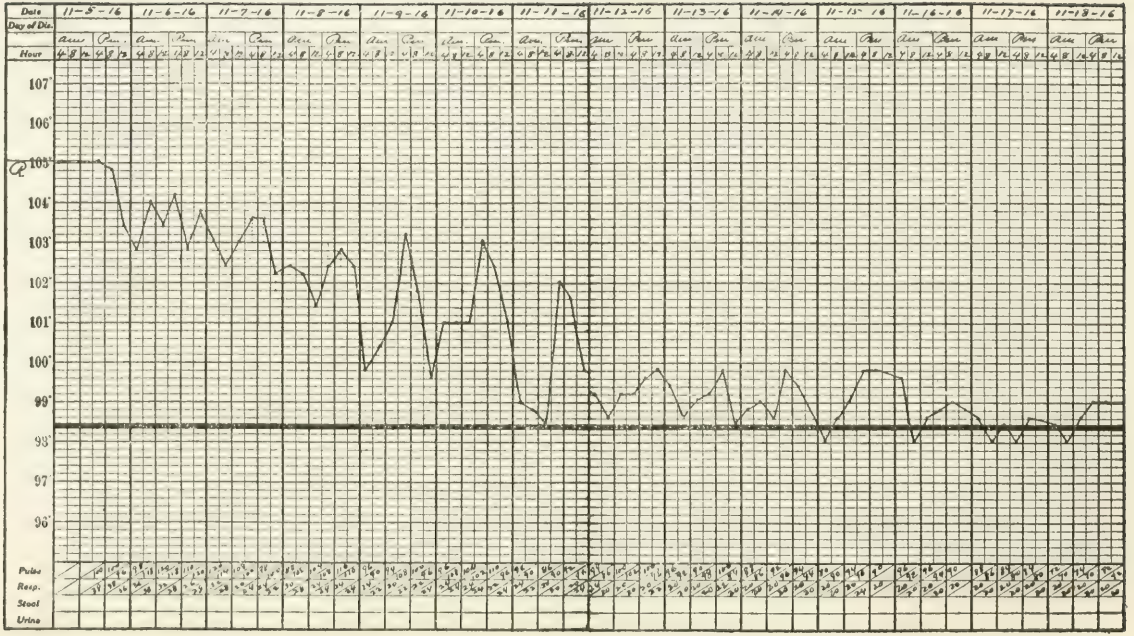

Fig. 144.—Case VIII. Temperature curve with gradual fall, no vaccine given.

Widal reaction was positive; blood-serum Wassermann negative. The rectal temperature at the time of the initial examination was 105° F., the pulse 100, respirations 38.

During the subsequent course of the disease a pyrexia was present, as represented in the temperature curve, the spleen became palpable, and questionable rose spots appeared.

Diagnosis.—Typhoid fever.

On the 10th of the month it was determined to give her an intravenous injection of typhoid vaccine. Owing to the smallness of the veins after unsuccessful attempts the effort was abandoned. On the following day the temperature at its highest point was one degree less, and on the second day the afternoon temperature did not exceed 100° F. Within the period of a week the temperature had become practically normal and the patient was convalescent.

Case 9.—A female, aged twenty-four years, a clerk, was admitted to the hospital September 19, 1916.

Present History.—Patient has not been feeling well for two weeks, but remained up and about until four days ago. The present symptoms consist of recurrent chills over a period of twenty-four hours, dizziness, and headache. The headache was present from the start and persisted during the following two weeks. It was of the frontal type and severe in character. Weakness and general malaise caused the patient to take to her bed four days before entering the hospital. Anorexia was also present. The temperature was not noticed until the last two or three days and was most marked in the afternoon. No gastro-intestinal disturbances have been present.

Past History.—The patient has always been well except for the diseases of childhood.

Physical examination was negative except for the finding of rose spots on the abdomen and a moderately enlarged spleen. A temperature of 103° F. was present on admission, with a subsequent rise on the following day to 104° F., which gradually subsided and reached normal at the end of the first week, as shown by the accompanying temperature curve.

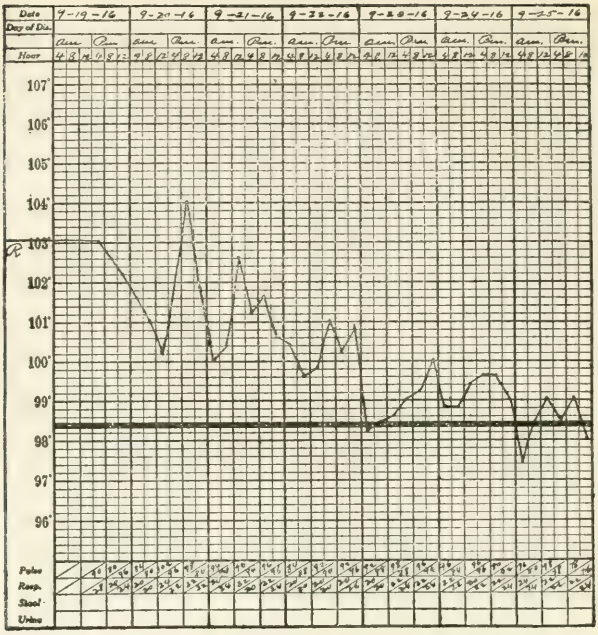

Fig. 145.—Case IX. Temperature curve, no vaccine given.

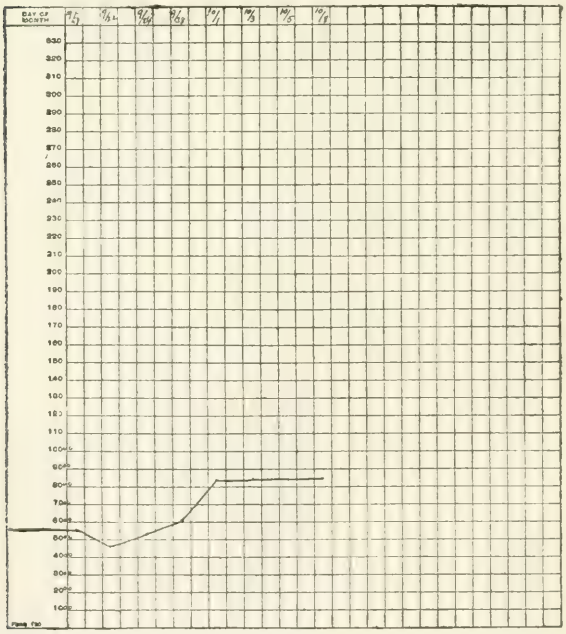

Fig. 145*a*.—Case IX. Leukocyte curve, no vaccine given.

Laboratory Findings.—Blood examination: hemoglobin 85 per cent., erythrocytes 4,064,000, leukocytes 5400. A blood-culture on the same day was negative; the Widal test was positive. Urinalysis: albumin was present with negative microscopic findings. Blood-serum Wassermann was negative.

Diagnosis.—Typhoid fever.

Case 10.—A female, aged twenty-one, a housewife, was admitted to the hospital December 11, 1916.

Present History.—Fifteen days ago her sickness began with a headache, which was frontal in type. This continued for a few days, coming and going. She felt sick all over. Six days ago she had a slight epistaxis. About a week ago a dry cough appeared, with difficulty in expectoration.

Just before coming to the hospital there was a sharp pain in the abdomen which lasted only a few minutes. Two days ago a doctor told her she had a temperature of 103° F. She thinks she has had fever for some time. Nausea has been present constantly for two weeks, but she has never vomited. A profuse diarrhea was present for three days following the taking of cathartics. The stools were light yellow; no blood was noticed. She has been constipated for the last two days. Pain and stiffness in the back of the neck was present the first day.

Past History.—She had the usual diseases of childhood; articular rheumatism at ten and fourteen years of age. She was also informed that she had a pleurisy and an organic heart disease. She has never had any sore throat, but has had considerable difficulty with her teeth. One child is living and well; no miscarriages.

Family history is negative.

Physical Examination.—The pulse is full and accelerated, rate 120. The tongue is dry and furred; the tonsils are hypertrophied. The thyroid is slightly enlarged. The spleen is not palpable. There are several rose spots on the chest and abdomen.

Laboratory Findings.—The urine is dark yellow, specific gravity 1024, acid reaction, albumin, with some epithelial cells, and granular casts. Leukocytes 8200; the microscopic Widal is positive. Wassermann reaction is negative.

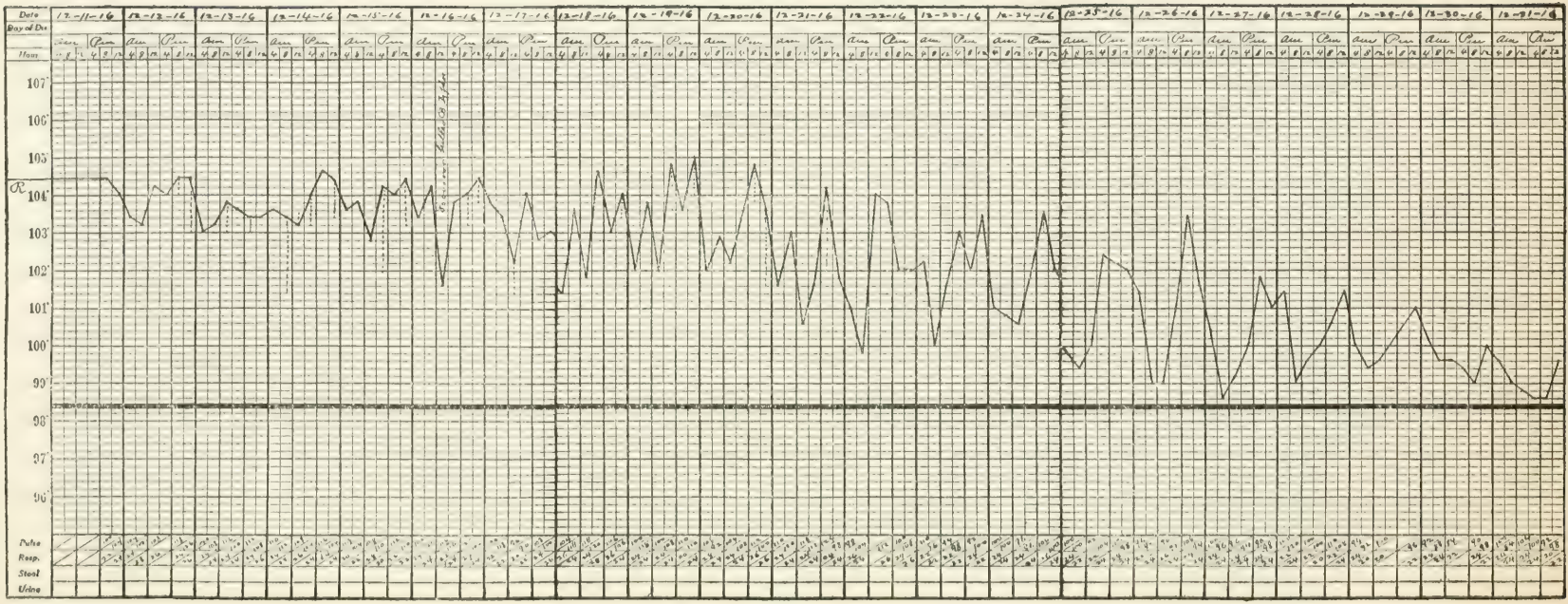

Fig. 146.—Case X. Temperature curve, no vaccine given.

The temperature on admission was 104.4° F., and has ranged from 101.4° to 104.4° F. since that time.

Diagnosis.—Typhoid fever.

Dec. 16th at 9.45 A. M. 50,000,000 killed typhoid bacilli were given intravenously. A slight chill occurred at 11.30 A. M., but not accompanied by any change in the temperature or subsequent course of the disease as indicated in temperature chart.

Conclusions.—So far as can be determined, when the vaccine treated typhoids are compared with the cases receiving no vaccine, there is little or no difference in the clinical course. If anything the untreated did better, and if they had received the vaccine it might have received the credit.

CLINIC OF DR. ISAAC A. ABT

MICHAEL REESE HOSPITAL (SARAH MORRIS MEMORIAL HOSPITAL FOR CHILDREN)

PYELITIS

Importance of Urinary Examination in Obscure Cases of Fever in Infancy and Childhood. Etiologic Factors. Ascending versus Hematogenous or Lymphogenous Infection. Clinical Picture and Course. Prognosis. Prophylaxis and Treatment.

THIS patient that I present to you this morning is a little girl seventeen months old. She was brought to the hospital on account of fever, failure to gain in weight, and marked general weakness. We are informed that this baby weighed 7 pounds at birth, and that the labor was normal. The baby was healthy during her first days of life. She was breast fed for the first two weeks, and then was given Horlick's Malted Milk in addition to the breast milk. Pretty soon, however, the physician advised artificial feeding on account of the mother's nervousness, so that at the end of the fourth month the mother discontinued breast feeding entirely and fed the baby on Horlick's Malted Milk exclusively. This diet was continued for several months, yet the infant did not gain in weight and was very weak. A milk formula was tried for a month and then Mellin's Food was added. The baby gained at first in weight, but soon declined. Another physician was consulted at about this time (six months), who advised milk-toast, the yolk of an egg, and orange juice. The child gained on this diet for a few days and then lost markedly. Finally the whole milk and the white of an egg was tried. The child continues losing in weight, remains fretful, and has frequent attacks of fever. The baby came into the hospital with a temperature of 101° F. There have been no convulsions. The

baby had a severe attack of diarrhea last July causing great prostration. She had a skin eruption in August which lasted two weeks, and the mother was told this was a heat rash.

Family History.—Father and mother are young, healthy, and intelligent people.

Blood.—The blood shows a hemoglobin of 65 per cent., red blood count 5,604,000, leukocytes 32,000.

We will now have the baby undressed and examine her more closely. This seventeen months old baby is extremely pale, painfully thin; the fontanel is open and sunken, though the sutures are closed. The head is rather square in the frontal region. The child has twelve teeth. The examination of the neck, aside from the thinness and the prominence of the vessels, shows no abnormality. The thorax is well formed, though partaking of the general emaciation. There is a slight rachitic rosary on both sides.

Percussion of the thorax reveals no abnormality of heart or lungs; the breath sounds and the heart tones are normal.

The spine is perfectly straight and shows no deviations. There is no splenic enlargement. The liver is normally palpable. The abdomen is only slightly distended. As the child cries you will note upon the surface of the abdomen some slightly enlarged, rather minute nodes which are thought to represent enlarged lymph-vessels.

The skin hangs loosely over the lower extremities, though there are no marked deformities of bone, no hemorrhages, no edema.

This baby was brought here from a distance because it was not doing well. Physicians and parents alike thought it was a question of finding the proper food. Referring again to the history, you remember the baby was given the yolk of an egg and milk-toast when she was six months old. Such feeding practice is a sad commentary on the lack of physiologic knowledge concerning infantile nutrition. Babies of six months should certainly not be fed eggs. We note, too, that the baby had a leukocyte count of 32,000, was running a continuous temperature, and was losing in weight. Every one took it for granted

that the baby was suffering from a food disturbance, though a complete examination had not been made. The baby should have been subjected to careful and complete examination. Nobody examined the urine, and so it is not only with this baby but with many others; they wither, suffer, and perish without having received a careful and complete physical examination. I am expressing myself in this way because I desire to lay emphasis on this fact, and particularly on the fact that the disease which we are about to consider is too frequently overlooked in young infants.

The urine from this baby contains a trace of albumin, has a specific gravity of 1020, contains no sugar and no acetone, though with the high-powered lens one sees the microscopic field swarming with pus cells. There are no red cells and no casts in this instance. You will note there is a daily variation, some days the urine contains a large quantity of pus and on other days very little or no pus. It is important to note, too, that there is no vulvovaginitis present which might give rise to a purulent urine.

In examining the specimen of urine under the microscope let me call your attention to the fact that while there are numerous leukocytes in the field, occasionally one notices them arranged in clumps as though possibly they were molded in shape by their passage through the ureter. Examining this specimen of the urine with the naked eye you will note that it is cloudy, contains numerous threads, and has all the appearances of a purulent urine. You will recognize at once that we have before us a baby suffering from a urinary infection which we speak of as a pyelitis. Let me again emphasize the fact that not every specimen of urine which is obtained from a pyelitis patient contains pus. Several specimens may be examined before the diagnosis is cleared by finding the pus. Possibly this occurs only in cases of unilateral pyelitis, in which the ureter on the diseased side becomes temporarily plugged with pus or clots of mucus or debris.

This baby, then, is suffering from urinary infection. We speak of it as pyelitis or cystopyelitis. This condition is one of the most common of all the so-called obscure causes of fever in

infancy and childhood. Very much has been written on this subject, and still we must dwell upon it again and again in order that you may become acquainted with it and recognize it.

Etiology.—This condition of pyelitis or cystopyelitis was first described by Escherich in 1894 under the caption of colicystitis. Urinary infection in children occurs more commonly in female than in male infants; it may occur in children of almost any age. It has been observed in infants eleven days old; it is very frequent during the last half of the first year and during the second year, though it may occur in older children, particularly girls. The colon bacillus is the organism most frequently found and, as has already been stated, the condition was designated as colicystitis by Escherich. Other organisms are sometimes identified, and rarely the tubercle bacillus may be responsible for the production of the disease. It is important to ascertain the avenue of infection. There are two principal theories: The first assumes that the infection of the kidney takes place by the pathogenic organisms finding their way into the urethra, ascending into the bladder, and escaping through the ureters into the pelvis of the kidney or into the kidney itself. The second theory assumes that the infection takes place through the blood or the lymphatics. It has also been suggested that possibly the infection may occur on account of a damaged intestinal wall, the organism proceeding through the lymphatic or vascular channels.

The theory of the ascending type of infection via the urethra and ureters has not been generally adopted. It has been doubted whether the offending organisms travel up-stream against a column of fluid. More recent investigation, however, seems to show that the organism does not travel through the lumen of the urethra, bladder, and ureter, but that it ascends through the periurethral and periureteral lymphatics. The periurethral sheath plays an important part in transmitting the infection upward. Other coats of the ureter may be involved, though the mucosa is found to remain intact. It has been shown that there is free communication between the lymphatics of the bladder and ureter and that the lymph-current is in an upward direction. We can, therefore, controvert the statement which has received

considerable acceptance that ascending infection takes place only through the lumen of urethra, bladder, and ureter. We may still assume that when the ureter is obstructed by calculus, stricture, or external pressure, urinary stasis occurs and infection is possible through the lumen of one or all of the urinary tubes.

It has been recently pointed out that the freely movable kidney is likely to suffer congestion either on account of tension of its vessels or the kinking of the ureter. Where congestion occurs in this manner, infection is very likely to follow. It is suggested that the urinary infections of infancy and childhood may be ascribed to faulty positions of the kidneys, and that somewhat older children suffering from pyelitis tend to improve or recover if forced to rest in bed. Very frequently, too, these little patients will suffer relapse if they are permitted to leave the bed too soon. The observations seem to show that by relieving the tension on the kidney and by permitting it to assume a more nearly normal position the congestion is relieved and the infection subsides.

The other view relating to the mode of infection refers to the lymphatic and vascular routes. It is assumed that the bacteria may pass from some focus of infection located somewhere in the body outside of the urinary tract to the kidney through the lymphatics and appear first in the fat capsule, from which point the infection may be distributed through the kidney by the lymphatics, or the organisms may reach the kidney through the blood-stream and localize in the pelvis of the kidney.

It has been shown that there is a direct lymphatic connection between the colon and the right kidney, and the right kidney is the one which is most often involved if the infection be unilateral. Therefore some writers believe that the bacteria pass directly from the intestine to the kidney by these lymphatic routes.

Referring to the mode of infection, notwithstanding the objections which have been raised to the ascending infection, the clinical facts seem to support this theory. The mere facts that little girls are most frequently attacked, that the ease of the ascending type of infection is very manifest, that the infection is for the most part caused by the colon bacillus, lead one to think

that the feces containing myriads of colon bacilli are carried forward from the end of the alimentary canal, contaminating the genitalia and the urinary organs. Thus it is easy to conceive how the ascending infection occurs.

Predisposing Causes.—We have already learned that a lowered resistance in the infant or a food disturbance is likely to be associated with an infection outside of the intestinal tract. We learned when considering decomposition that pyelitis was a frequent complication. It is a very common experience to note that a baby who falls ill with otitis media or grip or tonsillitis will show considerable pus in the urine if it be examined; or, on the other hand, a baby who has previously suffered from pyelitis and who has, to all intents and purposes, recovered, will frequently again show pus in the urine.

The Urine Examination.—Undoubtedly the reason that the diagnosis of pyelitis is so frequently overlooked is because of the difficulty in obtaining the urine in young infants, though the urine may be collected with but little difficulty by applying over the external genitalia a wide-mouthed bottle or an Erlenmeyer flask, which may be securely fastened by applying adhesive strips from the pubes to the perineum. Again, the infant may be allowed to lie on a rubber sheet or on oiled muslin in the center of which a slight depression is made. The urine will collect as it is passed and may readily be removed with a pipet. It is not injurious to a female child to introduce under aseptic conditions a small catheter into the bladder. Much more difficulty is encountered in catheterizing male children. The difficulty of obtaining urine is not as great as is frequently imagined. The characteristic findings of the urine have already been referred to. It is acid as a rule, contains numerous pus cells, frequently in clumps, may occasionally contain red cells, and where there is a renal complication or irritation tube casts may be present.

Symptomatology.—The symptoms vary with the age of the child and also depend on whether the disease is acute or chronic. In infants the most striking symptom is the high fever and the restlessness. The type of the fever varies considerably. The temperature may be as high as 104° or 105° F., may be constant

in character, assuming a so-called typhoidal type, or it may be characterized by marked remissions, partaking of a septic type.

The *physical examination* of infants suffering from pyelitis is usually without manifest finding. While the babies are extremely restless during the first days of the disease at least, there is no tenderness over the bladder or kidneys. During this period, notwithstanding considerable fever, the baby sometimes takes nourishment and will occasionally take notice of its surroundings. If during this early stage the urine be examined and the diagnosis be made, it will be found that the baby usually responds readily to treatment and recovery very quickly ensues. If, on the other hand, the disease continues for a number of days, more significant symptoms are manifested. The child becomes extremely pale. The pallor is such a striking symptom that an experienced clinician will almost immediately upon first sight think of the possibility of a pyelitis. The patient develops most stubborn anorexia, shows a facial expression which indicates fear and pain; objects to the sitting position in bed, and often shows a rigidity of the neck which may simulate meningitis. As the disease progresses the baby shows evidence of severe infection, complete loss of appetite, and inanition, and finally presents the picture of one suffering from marasmus or decomposition.

Notwithstanding the fact that the respirations are rapid, usually the physical examination of the lungs reveals no abnormality. Examination of the abdomen is difficult in most of these babies because of the abdominal distention, and in some instances both kidneys are palpable and seem enlarged. It has been maintained that enlargement of the kidneys indicates a pyelonephritis. I have on several occasions had these babies examined by urologists, who upon cystoscopic examinations have reported that the ureteral openings were swollen and that the urinary whirl which jetted into the bladder was cloudy, the same condition being found in both ureters.

It must not be assumed that all cases of pyelitis are of the same degree of severity. In some cases the general symptoms are mild, the fever is moderate, there is little diminution of ap-

petite, and the restlessness is not particularly marked. In the severer type, however, the symptoms are all more grave, the temperature, as has already been pointed out, may be continuous or intermittent, the pallor is intense, while the patients are, as a rule, restless and agitated; some become extremely listless. Jaundice may occur in the severer cases. Edema of the extremities has been observed. The patients sometimes suffer pain, and, indeed, it seems in some cases the pain resembles that of renal colic, possibly due to the passage of pus through the ureters. The children pass urine frequently and seem to suffer from mild vesical tenesmus, though, as a rule, the local symptoms, that is, those referred to the bladder and kidneys, are not very pronounced.

I have been able to follow some of these cases of pyelitis for a number of years. In some instances the infants had a single attack and recovered; in other instances the condition recurred throughout infancy and during the first years of life, becoming latent at the fifth or sixth year. In still other cases the condition seemed to become chronic. I have under my care at the present time a little girl nine years of age who has suffered from recurrent attacks of pyelitis since infancy. She is apparently a strong, robust girl, though she fatigues easily and is not capable of taking any continued exercise. If she falls ill with tonsillitis or a grippal infection she at once manifests a very marked recurrence of pyuria, or if she exceeds her usual amount of exercise, for example, if she takes a long walk, skates until fatigued, or takes an unusually long dancing lesson a febrile attack of pyuria is sure to follow. I may say in passing that this little girl is very much benefitted by prolonged rest in bed, and it is probable that in this case movable kidneys lead to the urinary congestion which produces the attack of pyelitis.

Complications.—It must not be thought that the infection remains confined to the pelvis of the kidney. In the severer cases the kidney substance itself may become inflamed, and, indeed, it has been thought that whenever the kidneys become markedly enlarged and tender the infection has extended into the kidney substance itself. I have myself seen several cases at autopsy in young infants in which both kidneys were honeycombed with ab-

scess cavities, rendering them useless as functioning organs. These are the severe cases that terminate fatally and are types of pyelonephritis.

Other complications, such as pyemia with purulent meningitis, have been reported in the literature. I have also the record of a case of a six weeks' old infant in my own service that was born with a horseshoe kidney, lying low in the abdominal cavity. A pyelonephrosis occurred in this case and the baby died from the resulting sepsis.

It has been generally thought that the disease is rare in little boys, though statistics have shown in some quarters that 20 per cent. of the cases have occurred in male children.

Prognosis.—Considering the large number of cases which are constantly occurring, the prognosis cannot be said to be unfavorable, but much depends upon the severity of the infection, much upon the length of time that elapses before the disease has been recognized, and also upon the general constitution of the infant. The nutritional state may determine somewhat the resistance against infection. The baby suffering from severe decomposition who falls ill with a pyelitis may have a great struggle to recover at all.

As a general rule those cases of pyelitis that are recognized early and properly treated yield readily, but this is not universally true. Some cases run a severe, almost malignant, course, notwithstanding an early diagnosis and the most skilful management and treatment.

Prophylaxis and Treatment.—Referring to the prophylaxis, those who accept the theory that the infection may be ascending in character may with some justice feel that the ascending infection might be prevented by better hygienic procedure in the cleansing and changing of the baby. Nurses and mothers should be taught that the baby should be cleansed by sponging from the front backward instead of in the opposite direction, and thus avoid forcing fecal matter into the urethra. It has been observed that cases of severe pyelitis occurred during the summer time when diarrheal conditions are prevalent.

The *dietetic treatment* consists first and foremost of combating

the anorexia. Infants suffering from this disease should be encouraged or even forced to take enough food to prevent inanition or starvation. Above everything else these infants should be given large quantities of water. On account of the very prevalent belief among mothers and nurses that a baby should not be forced to do anything that he does not desire to do, it is often difficult in practice to give these infants the quantity of fluids which they require. Nothing, however, is more important in the therapeutic management of these patients than to give fluids in abundance. In some instances it may be necessary to pass the stomach-tube and administer fluids in this manner, or it may be advisable to give the water by rectum, using the drop method of instillation. While this latter method is mentioned, it must be admitted that, as a rule, it is not successful. The baby's rectum very soon fatigues, the catheter is frequently expelled, and local irritation occurs. In the same way food may be administered to the baby by means of the stomach-tube. Those infants who are at the breast should not be weaned during an attack of pyelitis, as the breast milk is particularly adapted to combat infection and to conserve the baby's power of resistance. It has been recommended that malt soup may be given to these infants. This has been suggested because of the alkaline reaction of this food, though it must not be forgotten that malt soup as it is ordinarily prepared may be very laxative, and it may be necessary to considerably diminish the amount of malt soup extract in order to avoid its laxative effect.

When *medicinal treatment* is employed the free administration of water stands first and foremost. To young infants this should be given between feedings, and an attempt should be made to give between each feeding as large a quantity of water as is taken from the breast or bottle in the preceding feeding.

Of the various drugs that have been recommended, hexamethylenetetramin (urotropin) has probably been most generally used. I would, however, recommend a word of caution concerning its use. It should be under continuous observation and its use should not be continued for an extended period. The urine should be frequently examined for blood. I have more than

once seen severe and fatal nephritis which in my opinion was due to the overuse of urotropin. If urotropin is given to infants under one year of age it should be administered in 1-grain doses followed by water. This may be repeated four or five times daily. Older children may be given larger doses in proportion to their ages. Salol may be given in about the same dose, either combined with urotropin or given separately. Indeed, there are many men of wide experience who consider salol, given alone, a very valuable remedy in this disease. I may say that I have frequently used salol alone or in combination with urotropin and have satisfied myself that it is a useful remedy.

Recently Dr. John Thompson, a distinguished teacher of Edinburgh, advised the use of large doses of alkali. Dr. Thompson recommends 5 to 10 grains of citrate of potash, given at short intervals during the day. I have used this therapy in some severe cases, at times combining the citrate with bicarbonate of soda or bicarbonate of potash, and giving it until the urine became definitely alkaline. Sometimes these patients become afebrile under this treatment. The symptoms already referred to subside, although the urine may persist cloudy and contain pus for days thereafter.

I have never seen any beneficial results from bladder irrigation. Indeed, the treatment seems irrational if the lesion exists in the pelvis of the kidney.

So far as specific vaccine treatment is concerned, I am compelled to say from my own experience that it is disappointing. In those cases that were frankly colon bacillus infections I have used autogenous and stock vaccines without the slightest beneficial result in a single instance, and therefore cannot recommend the use of vaccines in the treatment of urinary infections in infants and children.

CLINIC OF DR. CHARLES SPENCER WILLIAMSON

COOK COUNTY HOSPITAL

THREE CASES OF PERICARDITIS

Purulent Pericarditis with Operative and Autopsy Findings. Hemorrhagic Pericarditis Complicating Acute Septic Endocarditis and Nephritis—Autopsy Findings.

Serofibrinous Pericarditis.—General Considerations.

CASE I.—PURULENT PERICARDITIS (PYOPERICARDIUM), WITH A DISCUSSION OF PERICARDOTOMY BY DR. KELLOGG SPEED

November 4, 1916.

THE patient whom I wish to show you today is a Bohemian tailor, aged forty years, married, who came into the hospital late yesterday afternoon with the examining-room diagnosis of "acute miliary tuberculosis." His complaints were the following: First, fever and chilliness; second, cough; third, sleeplessness; fourth, pain in the side; fifth, loss in weight and anorexia.

Onset and Course.—The patient states that previous to eight days ago he felt perfectly well; then when he got up in the morning and went to work he commenced to have chilly sensations and fever. He went home from work at noon, went to bed, and has remained in bed ever since. He has had little or no appetite during this time.

The pain is in the precordial region and has been present for the entire eight days. It is sharp, and he thinks it is increased somewhat by deep breathing, but not by coughing. It does not radiate to the back, to the arms, or to the shoulders.

The cough has been present for about four days and is productive. The sputum is mucopurulent. He says he did not cough at all previous to four days ago.

He thinks he has lost about 15 pounds in the last five months. For the past eight days he has been utterly unable to sleep and feels worn out on that account. The loss of appetite is almost complete; he has taken nothing but milk for the last eight days. There has been some slight headache. The bowels move once a day.

Past History.—He has had nothing of consequence excepting typhoid twenty years ago. He denies venereal infection of all sorts.

Family History.—His mother died of tuberculosis, his father of apoplexy. He has a wife and one child living and well.

Habits.—He is a total abstainer and has been for a number of years. He does not chew or smoke.

Physical Examination.—The patient looks to be approximately the age stated. He takes very little interest in things happening around him and answers very imperfectly to questions. The skin has a slightly subicteric tint. The sclera of the eyes are pearly white.

The *scalp*, *ears*, and *nose* are negative. The *eyes* show a slight inequality in the pupils, the right being a little smaller than the left. They react to light and accommodation and there are no other abnormalities. The *mouth* shows many decayed teeth. The gums show no lead line; the tongue is heavily coated.

The Neck.—There is considerable distention of the cervical veins, but no abnormal pulsations. The glands of the neck are not palpable.

The *extremities* are negative.

The *thorax* is symmetric, but apparently there is some retraction of the lower interspaces on both sides. The Litten phenomenon is absent on the left and greatly impaired on the right side.

The *lungs* anteriorly show some diminished resonance over the lower portions, and over these areas numerous subcrepitant râles may be elicited. The tactile and vocal fremitus are perhaps slightly exaggerated over these lower portions. Posteriorly, there is dulness on the left side over the two lower interspaces; over this region there is diminished tactile and vocal fremitus and

the breath sounds are practically absent. We will defer the examination of the heart for a moment.

The *abdomen* shows no general tenderness or distention. The liver can be plainly felt about one fingerbreadth below the um-

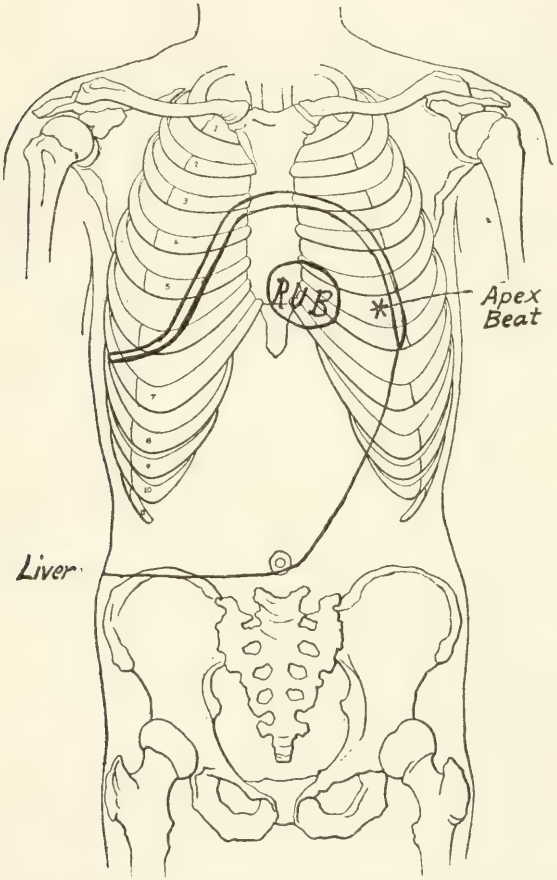

Fig. 147.—Purulent pericarditis showing the outlines of areas of absolute and relative dulness. The friction-rub could be heard over the area shown, although the sac contained 16 ounces of pus. Note the persistent apex-beat and the rounding off of the cardiohepatic angle, with marked flatness in fifth right rib.

bilicus. The edge is rounded and sharp. On pressure over the liver it is distinctly tender.

Fig. 148.—Pulse tracing, case of hypopericardium.

The *genitalia* and *reflexes* are all normal.

The principal interest in this case centers about the *heart.* We find the apex impulse with its maximum intensity in the fifth intercostal space in the nipple line. It is not more forcible than normal; if anything, a little weaker. Percussion shows the right border of the heart sloping downward and outward almost in a straight line, so that the cardiohepatic angle is almost obliterated. The left border extends one inch beyond the apex. There are no thrills to be palpated. On auscultation the heart tones are loud and are heard all over the heart excepting at the actual apex itself, where they are somewhat diminished. No murmurs can be heard. The pulmonic and aortic sounds are all of normal strength and in their respective areas. In the fifth intercostal space, just to the left of the sternum, a very distinct scratching rub can be heard, which is neither pure systolic nor pure diastolic in time. At times there are three beats in each cardiac cycle. On pressure with the stethoscope over this rub it is made distinctly louder, and the patient complains of some pain when this is done. The pulse ranges from 110 to 116, is irregular and of low pressure, the systolic being 110, the diastolic 70. The tracing shows these points very well.

The *temperature* since his entrance to the hospital has not exceeded 98.6° F.

Laboratory Findings.—The urine is of dark amber color, specific graviy 1028, acid reaction, and shows a trace of albumin. A blood count showed 22,400 leukocytes, with a differential count of 89 per

cent. polymorphonuclear neutrophils, 8 per cent. small mononuclears, and 3 per cent. of the other varieties.

Diagnosis.—When we consider how very indefinite the symptoms are, and in view of the fact that the patient has had no rise in temperature since coming into the hospital, we are unable to even guess at a diagnosis from the symptoms alone. It is very evident that the patient is acutely and seriously ill. This is manifest from his general stuporous condition—the rapid, weak, irregular pulse, and the general picture of asthenia. The clue to the diagnosis lies in the physical signs as they relate to the heart. The striking features are these:

First. The right margin of the heart does not meet the lung-liver boundary at a right angle or a trifle less, as is normally the case. On the contrary, the angle is almost entirely obliterated and forms almost a straight line.

Second. The left border goes out one inch beyond the apex.

Third. At all points there is no more than the width of one finger's difference between the relative and absolute dulness. This is especially marked to the left.

Fourth. The dulness extends up higher along the sternum to the left than is usually the case.

Fifth. There is an unmistakable to-and-fro pericardial friction-rub just to the left of the sternum. The pericardial character of this rub is made certain by its superficial nature, the fact that it is confined neither to the systole nor to the diastole, but overlaps and sometimes shows three sounds in the cardiac cycle. These points are more easily appreciated by listening to the heart than by my description of them.

The physical examination of the lungs indicates that there is a slight consolidation at the left base, the nature of which is not very apparent. The physical signs further indicate a probable tuberculosis at the right apex.

We must ask ourselves how we can make these physical findings fit in with the history and with the high leukocyte count which he has. The fever, chilliness, cough, and pain in the left side do not point to anything very definitely, especially since the patient is so befogged mentally that he does not give any of these

points with clearness. We have, then, nothing but the physical signs, which indicate clearly a pericarditis with effusion, to rely upon. Just before bringing the patient to the clinic we had him fluoroscoped, and the fluoroscopic findings, while not very pronounced, have confirmed us in the belief that there is a pericardial exudate. I call your attention, however, to one very striking feature, and that is the absence of temperature abnormalities. As I said before, the temperature has not exceeded 98.6° F. since the man came into the hospital. In the great majority of instances pericarditis with effusion is a febrile condition. We would expect under ordinary circumstances to have a temperature of 101° or 102° F. The leukocyte count of 22,400 indicates that there is an exudate, and speaks very strongly against this being of a tubercular nature, especially when we consider the very pronounced increase in the polymorphonuclear neutrophils. There is a very striking contrast, to my mind, between the profound prostration of this patient, the fact that he is evidently very seriously ill, and the absence of abnormal temperature and apparent freedom from pain at the present time.

Aspiration of the Pericardium.—The high leukocyte count led Dr. Robbins to suspect the possibility of a purulent exudate, and on aspiration of the pericardium for diagnostic purposes he obtained a syringeful of thick, creamy pus, which contained the pneumococcus in pure culture, judging from an examination of a smear. He was aspirated only a few hours ago, and on going over him I concurred entirely with Dr. Robbins' diagnosis of a purulent pericarditis with a considerable effusion, and have brought him up here to the clinic to show you how such a case looks, for they are not, in our experience, very common in medical practice.

Etiology.—Our next question is, What is the origin of this pericarditis? My experience is that where there is no history of injury, and where there is no complicating empyema or sloughing process in the structures about the pericardium, the majority of cases follow pneumonia, and we must ask ourselves whether the physical signs in the lung justify the diagnosis of pneumonia. When we consider that the entire process is eight days old, and

that we have no outspoken evidence of pneumonic consolidation in the lung now, such as we might expect if the patient had been taken sick with a lobar pneumonia at that time, we must be very reserved in our judgment. Whether or not the condition actually started as a pneumonia, the smears make it perfectly evident that it is a pneumococcic infection and apparently a pure one, so we must bear in mind the possibility of a general pneumococcic septicemia with the localization especially in the pericardium.

Treatment.—I saw this case for the first time a couple of hours ago, and at once the all-important question of *treatment* came into my mind. What should be done with a case of this sort? The answer is perfectly self-evident. An accumulation of pus in the pericardium should be treated precisely the same as an accumulation of pus anywhere else—opened freely and drained. The particular point which I wish to emphasize is that, *whereas it may not do a great deal of harm to procrastinate a greater or less length of time in abscess in certain localities, in pyopericardium this is never admissible, for several reasons.* The first of these is that the fluid is constantly accumulating and there is no possibility of its spontaneous subsidence, so the patient is in constant danger of death from compression of the vena cava and the auricles interfering with the filling of the heart. A case of this sort should be operated on just as soon as diagnosed. If any further reason were necessary it can be found in the fact that the longer a case runs, the greater the danger of the myocardium becoming infected, and a purulent myocarditis is almost invariably fatal. Acting on the suggestion I have already made, the case has already been transferred to the surgical service and will be operated on as soon as Dr. Speed arrives. Some of you may have an opportunity of seeing the operation, and for those of you who do not I will report the result of the operation at the next clinic hour.

While waiting, however, for Dr. Speed's arrival it may be as well to discuss some of the other points which are suggested by this case. What is the explanation of the large and tender liver? The reason for this is generally twofold. To begin with, when the pericardial exudate is very large the diaphragm is pushed down and with it the liver; in order that the liver should be pushed down

as far as this, namely, below the umbilicus, it would require an exudate of enormous dimensions, and our physical examination of the heart does not warrant the conclusion that this exudate is a very large one. On the contrary, there is reason for thinking that it is of moderate proportions. I think the explanation for the large size and the tenderness of the liver is to be found in another direction. I believe it is due to an impairment of the circulation; in other words, that it is the result of venous congestion. Practically all clinicians agree that even moderately sized pericardial exudates seriously interfere with the heart, and this is especially true when the fluid is purulent in character. If we are correct in our suspicion that the latter of these factors—namely, the venous congestion—is the important one, when the fluid is removed by operation the patient should show immediately a striking improvement, and if the case proceeds to recovery the liver should go down in the same proportion that the heart recovers its strength.

There is one further bad feature about this case, and that is, the length of time that the exudate has probably existed. So far as we can ascertain, the chilly sensations have been present for eight days, but we have no way of ascertaining whether these chilly sensations marked the beginning of the pericarditis. Probably they did, but in any event, with fairly thick, creamy pus, we may be sure that it has been there for some time, much longer than we wish it had, because in cases where pus remains in the pericardium very long the prognosis becomes correspondingly bad. *One of the most striking features of this case is the entire absence of abnormal temperature in the day that the patient has been in the hospital.* We are accustomed to think of purulent exudates in both pleura and pericardium as associated with rigors, sweats, and septic temperature. This case has presented none of these, except that the man states he felt chilly in the beginning of his illness. Cases of this sort might be very readily overlooked, and I can congratulate Dr. Robbins on making the diagnosis so promptly and efficiently.

PYOPERICARDIUM—PERICARDOTOMY

From the Surgical Clinic of Dr. Kellogg Speed, Cook County Hospital

The medical history and physical findings in the case of this patient, forty years old, have been clearly set forth by Dr. Williamson. I wish to give you the subsequent treatment and clinical course after his transfer to my surgical service on November 4, 1916.

Pre-operative Symptoms.—At that time the pulse was 120, irregular and arhythmic, the man was cyanosed, in respiratory distress, complained of chest pain, and was very anxious about himself. The blood count showed 22,400 leukocytes, the differential 89 per cent. polymorphonuclears, and the aspirating needle had demonstrated the pyopericardium.

Technic of Operation (Pericardotomy).—Within an hour he was sent to the operating-room, and a linear infiltration of the skin and deeper tissues from the third to the sixth rib, about an inch to the left of the sternal margin, with ½ of 1 per cent. novocain permitted rapid access to the chest cavity. The cartilage of the fifth rib was exposed and identified, severed with a sharp knife, and 1 inch of its continuity removed subchondrally. Before opening the pericardial sac an aspirating-needle was inserted into it and thick pus was withdrawn, the needle discovering the moving heart beneath. The pleura, lung, and internal mammary vessels were not injured in any way until the pericardial sac was slit open, when the internal mammary vein was severed and tied at once because it interfered with a wide aperture.

From the pericardial sac now poured out 16 ounces of thick creamy pus. Cultures were taken at once, both from the aspirated and discharging pus, all of which showed pneumococci later. By retracting the pericardial opening I was able to see the shaggy heart within and watch its action. The auricular and ventricular systoles were plainly made out, and a finger slipped into the opening palpated a large part of the cardiac surface, failing to find any adhesions or walled-off pus cavities. Three guttapercha drains were placed in different parts of the pericardium.

Postoperative Symptoms.—Early during the liberation of the imprisoned pus the heart became steady and slower, the cyanosis

and dyspnea disappearing within five minutes. Within an hour the pulse-rate had fallen to 76. That night the left pupil remained about twice the size of the right, but was round. A slightly febrile course continued from day to day. On November 7th the pulse rose to 120 and was not so strong as it had been, while the left pupil was found to be but slightly larger than the right. Drainage was free, but in the presence of some cardiac embarrassment I adopted a prone position for the patient for a half-hour at a time, providing it caused no distress. The pus flowed out very satisfactorily in this position. On the 10th of November the patient was in very good condition, he had been shown in the clinic, and several observers were able to see the heart beating through the open wound. To attempt to alleviate the profuse suppuration, daily irrigation of the pericardial cavity with 1 : 5000 solution of bichlorid of mercury was begun. Care to allow a free return of fluid obviated any cardiac disturbance. The next day the temperature rose to 102° F. and the pulse quality was poor, a beat being missed occasionally. The septic condition persisted. On the 20th he had a slight hemorrhage from the mouth after five days of nausea, and gradually failed, passing away on the 21st, seventeen days after operation. The drainage remained profuse to the end.

An autopsy was obtained and the findings are here given:

Anatomic Diagnosis.—Acute, fibrinous, purulent, pneumococcal pericarditis; recent surgical incision over the fourth left costal cartilage; hypostatic pneumonia of the dependent portions of both lungs; healed and calcified tuberculosis of the right lung; healed and calcified tuberculosis of the peribronchial lymph-glands; traction diverticulum of the upper third of the esophagus; bilateral fibropleuritis; cholelithiasis; pyorrhœa alveolaris.

Examining our case in the light of the autopsy findings, we find the purulent pericarditis which we knew to be present, and a healed tuberculosis in the right lung, as well as in the peribronchial lymph-glands. The finding of the traction diverticulum is interesting, and testifies probably to the fact that the peribronchial lymph-glands had healed out a long time previously. The cholelithiasis had made no symptoms and was an incidental finding.

Remarks.—In reference to this isolated case of pyopericardium I wish to call attention to these points. The dilatation of the left pupil, I believe, was caused by pressure on or irritation of the left cervical sympathetic. If this finding had been caused by the calcified peribronchial lymph-nodes on the esophageal diverticulum it seems unusual for its partial subsidence within a short time after the drainage of the pus. In the literature I find no reference to this sign in similar cases and would suggest its value.

Posture.—Treatment by the prone position for short periods is also unmentioned—it has distinct value. Irrigation is of doubtful value. Like every abscess, pyopericardium demands primarily free drainage; irrigation seems to fail to shorten the course and may be a source of danger. In Rhodes' case (Annals of Surgery, lxii, 660–677) he used a 1 : 3000 bichlorid irrigating solution and elicited symptoms of heart pressure. Parker avoided this in his case. Hot normal salt, boric solution, or weak bichlorid may be used. Solutions of hydrogen peroxid should be avoided for obvious reasons.

Considering the surgical anatomy, I see no advantage given by Roberts' chondroplastic method (Amer. Jour. Med. Sci., December, 1897) in which he raises a trap-door flap on the front of the chest, exposing lung, pleura, and mammary vessels. As the operation of pericardotomy is always urgent, and the one thought is drainage and not a subsequent closure, I feel that most cases can be approached quicker and in a simpler manner through the linear incision described. In spite of the distended pericardial sac, it is probably true that the pleura is not to any appreciable degree stripped back from its anchorage to the front of the thoracic wall. Consequently the safest approach is through the fifth rib or interspace to the left of the sternum—outside the internal mammary vessels, and not through Rotch's or other selected points to the right of the sternum or farther to the left of the parasternal line. This has been demonstrated by röntgenograms taken of cadavers with pericardial sacs distended by injection. Paracentesis of the pericardium should be used as a diagnostic method only. Its drainage is inefficient and the pericardium is more elastic than the pleura. One would anticipate

better results from its thorough drainage by pericardotomy. The needle in paracentesis may injure the heart muscle and obtain no return of pus or penetrate into the pleural cavity and contaminate it. Thick pus or shreds may block the needle. Drainage after open operation may be furthered by stitching the pericardium to the skin. Rubber tubes and gauze wicks are not advisable—gutta-percha strips are the best drainage material.

The interesting condition of "Herzdruck" is usually of slow development. The respiratory embarrassment, the orthopnea, the cyanosis, pericardial pain, distended neck veins, chest edema, and occasionally pain in the left arm are characteristic symptoms. As the pressure increases a final condition of "Herztamponade" is reached when the intrapericardial tension becomes greater than the intra-auricular pressure and the heart ceases to beat.

The prognosis of the reported cases varies according to the promptness of drainage and the presence of complications. Delay in pericardotomy leads to general septic infection with exhaustion of the patient or cardiac debility and fatty myocardium. Roberts collected 35 cases up to 1897, 15 of which recovered (43 per cent.). Of the 20 fatal cases, 10 were generally septic from lesions of the pleura, lungs, kidneys, etc., before operation. Rhodes (1915) found a total of 73 cases in the literature up to 1909, and then added 13 more, so that there are now possibly 90 cases on record.

Other References:

Porter, Annals of Surgery, 1900.
Eliot, Annals of Surgery, 1909, xlix, 60.

CASE II.—HEMORRHAGIC PERICARDITIS, WITH ACUTE SEPTIC ENDOCARDITIS

November 4, 1916.

This patient is a painter, aged forty-nine, an American, who came into the hospital on October 23d complaining of swelling of the face, legs, and abdomen. He has not worked during the last two months. He coughs a little and brings up white, frothy sputum. He has been short of breath for two months. His appetite is good, he has no pain, his bowels move two or three time a day.

Past History.—He had chickenpox in childhood, lead-colic several years ago, gonorrhea twenty years ago, and hard and soft chancres about the same time.

Family History.—His father and mother are dead; he has sisters living and well.

Habits.—He drinks half a gallon of beer a day, or did for several years, but has not done so recently. He drinks several whiskies each morning.

Examination.—His scalp, eyes, ears, nose, and throat were negative, with the exception that the optic disc seemed a little bit hazy. The mouth showed the teeth in bad condition. The veins of the neck were greatly distended; they filled from below, but there was no special pulsation. The arms showed a slight edema, but there was no clubbing of the fingers and no capillary pulse. No enlarged glands could be felt anywhere. The pulse was regular, rapid, and of low tension. A great many hemorrhages were to be found on the skin of both legs; the Babinski was absent, the knee-jerks present. There was some varicocele on the left side.

Examination of the *abdomen* shows a shifting dulness in the flanks and above the pubes, and there is no doubt that he has free fluid in the abdomen. In the upper part of the abdomen we find again a great big mass almost exactly the duplicate of the previous case. About three fingers below the ribs we find a smooth, hard mass which extends to the umbilicus in the middle line, and then goes up and meets the ribs about an inch outside the nipple line on the left side. The dulness extends to the lower margin of the fifth rib and the relative dulness is about an inch higher. He has, therefore, a very large liver, which is smooth, hard, and exquisitely tender. There is no enlargement of the spleen in this case, but the liver goes over so far to the left that one might mistake the left edge of the liver for the spleen if not careful.

The *lungs* show no dulness anteriorly, but there are a few faint, moist râles in each axilla. The posterior apices are normal; there is no dulness, no bronchial breathing, no increased fremitus, but a few moist râles can be heard over the bases posteriorly.

The Heart.—Examination now shows that the apex impulse is

not definitely palpable. On admission there was a very clean-cut to-and-fro rub that could be felt over the apex. This cannot be felt as plainly now as it could a few days ago. On entrance the left border was in the midclavicular line, the right border sub-

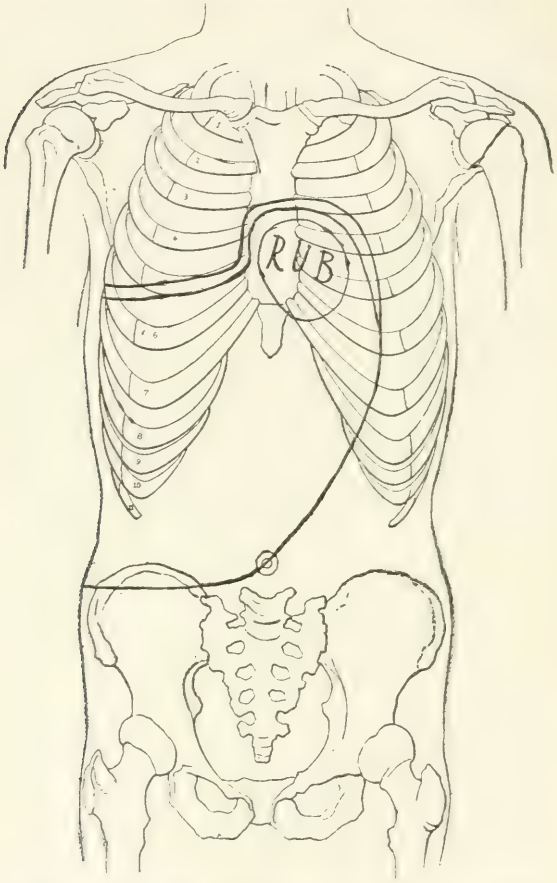

Fig. 149.—Pericarditis with small amount of fluid. Note the absence of the apex impulse and the very large size of the liver due to passive congestion.

sternal. On auscultation a very beautiful to-and-fro rub could be heard over the entire cardiac area. No murmurs were heard, but the rub was so loud that one could probably not hear murmurs if they were present. The right border is still substernal. The

cardiac area is not very greatly increased. On auscultation at present the first tone at the apex is almost entirely gone, there is a to-and-fro friction-rub which gets louder and louder and reaches its maximum intensity over the lower third of the sternum. This rub is neither purely systolic nor diastolic—it is both systolic and diastolic. What I mean is, that when you come to differentiate endocardial from pericardial conditions, you find in endocardial lesions that you get murmurs which are definitely associated with a particular phase of the cardiac cycle, whereas in pericardial conditions this is not the case, as I have already emphasized. In the patient before us there cannot be the slightest question as to the nature of the sound. It is typically pericardial; superficial and scratching in character, both systolic and diastolic, and yet neither purely systolic nor purely diastolic. This rub is so characteristic that one would not hesitate for a moment to say that it is unmistakably pericardial.

We find, then, a heart the right border of which is substernal or just at the right margin of the sternum; the left border at about the nipple line or a little outside of it, so that the heart dulness is now not so great as on admission. This is in all probability due to the fact that the patient has been on digitalis and that the dilatation has become somewhat less pronounced.

On examination of the skin we see that at the present time the condition is different from that on admission. When he came into the hospital there were numerous hemorrhages, particularly over the skin of the abdomen and thighs. At the present time these hemorrhages are very much more numerous and, as you see, they are so plentiful on the chest, particularly in the lateral regions, that we can hardly put the tip of a finger in between them. They vary in size from a pin's head to a cross-section of a pea. They have come out in successive groups, and the last group, which appeared a day or so ago, was very extensive, so that now they form a most striking picture in the patient's general condition. In addition, the patient shows a well-developed edema of the legs and in the posterior portion of the trunk, particularly over the sacrum.

We have done a fair amount of laboratory work on the patient

and have more under way. The urine shows a specific gravity of 1013, acid reaction, and a rather large amount of albumin, about ½ of 1 per cent. by weight. Numerous erythrocytes are present and a good many coarse and fine granular casts. The blood-pressure is 160 systolic and 60 diastolic. Examination of the blood shows 15,900 white cells with 58 per cent. hemoglobin. The differential white count gave 82 per cent. polymorphonuclears, 6 per cent. large mononuclears, 10 per cent. small mononuclears, 1 per cent. myelocytes, and 1 per cent. eosinophils. The Wassermann test on the blood was negative.

Diagnosis.—When we come to formulate our diagnosis from these findings we will do well to begin with those which are most unequivocal. In a patient who complains of swelling of the lower extremities and abdomen and a certain amount of swelling of the face, who is extremely short of breath, who coughs, and who shows the manifest indications of a chronic nephritis with a high blood-pressure, there can be no doubt that whatever else the patient may have, he has some type of chronic nephritis. There can be little or no doubt that the great swelling of the liver is due principally if not entirely to this passive hyperemia. The findings on the part of the heart are quite easy to interpret in one way and quite difficult in another—easy in the sense that we have unquestionably a fibrinous pericarditis—the rub is so plain as to make no other diagnosis tenable. The question as to whether there is an effusion in the pericardial sac is not so easy to answer because the case is not an uncomplicated one.

What makes me hesitate in regard to the diagnosis? The following points seem to me worthy of consideration: If our diagnosis of chronic nephritis is correct, we should expect a well-defined cardiac hypertrophy with an increase in the strength of the apex-beat even though the patient has a broken compensation. This is not absolutely imperative, but one generally finds some evidences of the apex-beat even where compensation is very badly broken. The fact that we do not get an apex-beat where we expect it, and the fact that we have an unmistakable fibrinous pericarditis, makes me suspect pretty strongly that we have a certain amount of effusion within the sac, and that this effusion is

probably the thing which is preventing the apex-beat from manifesting itself. As a matter of fact, in most cases of fibrinous pericarditis there is some effusion, but this is by no means so invariable that we are compelled to assume an exudate in every case. My judgment is that he has a fibrinous pericarditis with a small amount of exudate not sufficient to produce the characteristic changes in the percussion outline that we generally expect with a large amount of fluid.

Now have we exhausted the diagnostic possibilities with a chronic diffuse nephritis and a pericarditis? This latter we know occurs very commonly as a terminal event in chronic nephritis. There are two points which to my mind indicate very clearly that neither of these things is the principal factor in this patient's condition. One is the persistent fever. The patient has been running a slight up-and-down temperature ever since he came into the hospital. It has never been high, but on one occasion reached 102.4° F., and on many occasions has been over 101° F. Second, there are the numerous hemorrhages. One can find in all sorts of chronic disorders a few hemorrhages in the skin. That is nothing unusual, nor does it call for any special comment, but in this patient the hemorrhages have been so extensive and are increasing so constantly in extent and number that it makes us think of something else, and that something is a septic process somewhere, particularly an endocarditis. You will remember that I have said to you on several occasions in previous clinics that when a patient whose heart has been in a fair state of compensation suddenly shows evidences of severe decompensation, especially with fever, it should invariably make you think of an acute endocarditis.

Now let me make these points clear to you. The patient certainly has a chronic diffuse nephritis. This explains the shortness of breath, the high blood-pressure, the enormously swollen liver, the edema of the feet and lower extremities, and the slight edema of the face. It is also the principal cause of the pericarditis, or at least it is an adequate cause. A pericarditis when it is terminal is frequently without fever, so there still remains to be

explained the fever, these very numerous hemorrhages in the skin, and the sudden onset of decompensation.

With these points in view we have had a blood-culture made and succeeded in cultivating on two separate occasions a pure culture of streptococci from the blood. This, of course, goes a long way toward strengthening our diagnosis. Indeed, it makes it practically certain, so that this will now read: Diffuse nephritis, secondary cardiac decompensation, serofibrinous pericarditis with a small amount of fluid, general anasarca with a small amount of ascites, and an ulcerative endocarditis of the septic type. This latter condition explains the apathetic, typhoid-like state in which you now see the patient. If our diagnosis is correct the prognosis is self-evident. The probabilities are that it will run a fairly rapid course. It is difficult to predict just what the outcome of this case will be, for he has two conditions, either of which is likely to prove fatal: namely, the nephritis with broken compensation and the acute endocarditis. It is worth while noting that the phenolsulphonephthalein test shows that only 1 per cent. came through in the first hour. At the end of the second hour the patient could not urinate and there was no one at hand to catheterize him, but at the end of the third hour he succeeded in urinating, and we found 5 per cent. additional, so that he passed a total of 6 per cent. of phenolsulphonephthalein in three hours. This output is so low as to make us think pretty strongly of impending uremia.

The nature of the exudate in the abdomen and pericardium cannot be definitely ascertained except by aspiration, which is not justified in this case. My experience has taught me that in cases of endocarditis where there are extensive hemorrhages in the skin that any exudate present is likely to be of a hemorrhagic nature. I merely mention this because I know of no way of settling the nature of the exudate except by exploratory puncture, which, as I have said, I do not consider justifiable in the patient's condition. Indeed, in the case of the pericardium we are not absolutely certain that there is an exudate present, although I think it probable.

Note (November 10th).—You will remember the patient

whom I showed you at our last clinic, in whom we made the diagnosis of an old chronic nephritis with broken-down heart, and in whom we made the further diagnosis of serofibrinous pericarditis with an acute septic endocarditis due to streptococcus infection, with multiple hemorrhages in the skin. The patient was in comparatively good condition at that time, but became rapidly worse. The general typhoid-like condition became more and more pronounced, the temperature range became progressively higher toward the last, reaching 102.6° F. in the evening and coming down to approximately normal in the morning, a typically septic temperature. His condition grew so rapidly worse that it became evident he could not last long, and he died day before yesterday, just five days after I showed him to you. The further history of his case was rather instructive. On the 5th we find a note that his condition was very poor. On the 7th we find the following note: "The patient had a severe attack of dyspnea and cyanosis, with weak, thready pulse. Is now in semicoma and has had a few clonic convulsions. General condition is very poor." On the 8th, the day of his death, we read that "The patient had another attack of dypsnea with cyanosis and convulsions. The pulse became imperceptible and during the attack death ensued."

The occurrence of convulsions and coma toward the end leads us to think that the actual cause of death was uremia. We were fortunate enough to secure an autopsy, and I will read you from the autopsy report the salient points:

Anatomic Diagnosis.—Acute thrombo-ulcerative and vegetative aortic streptococcal endocarditis; disseminated petechial hemorrhages throughout the skin; marked hyperplasia of the spleen; acute fibrinous pericarditis with hemopericardium; hemoperitoneum; chronic diffuse nephritis; edema of the brain; hypertrophy of the left ventricle of the heart; edema of the lower extremities; marked passive hyperemia and beginning atrophic cirrhosis of the liver; passive hyperemia of the dependent portions of both lungs; nodular (syphilitic) sclerosis of the arch and thoracic portion of the aorta; multiple stellate (syphilitic) scars over the liver. The other findings were unimportant for our purpose.

When we re-examine the case in the light of the autopsy findings we see that our conclusions were quite justified. He had the chronic nephritis which we postulated; also, the acute streptococcal endocarditis. The exudates were also hemorrhagic, although this, of course, was more or less of a guess on our part. As is generally the case in an autopsy of this sort there was something of interest in the case which we did not know, and that is the

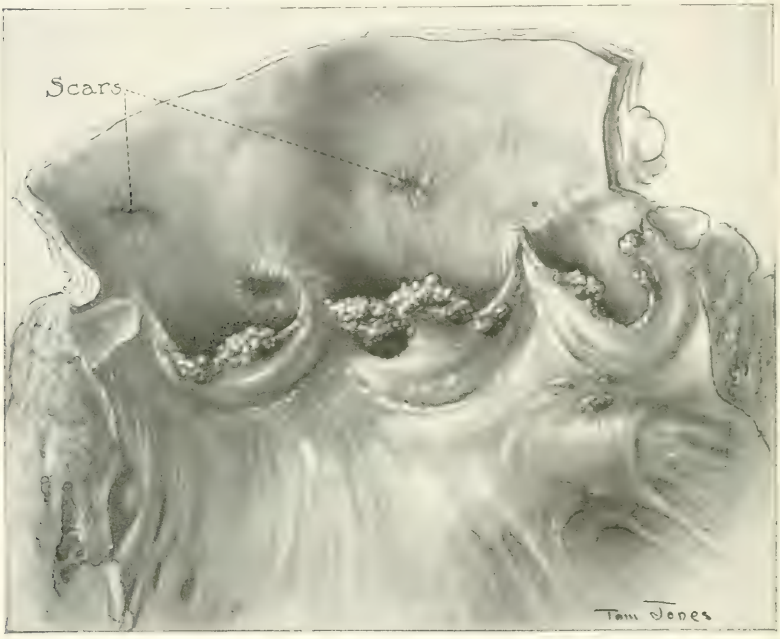

Fig. 150.—Acute thrombo-ulcerative streptococcal aortic endocarditis showing perforation of one valve segment. The scars in the aorta are the remains of a syphilitic aortitis. (Personal observation.)

luetic aortitis. We had suspected the possibility of this; indeed, it would be more correct so say that we suspect it in every cardiovascular case, and we sent the blood for the Wassermann test with the notation: "Suspected syphilitic aortitis." The Wassermann on the blood was negative, although there had been, so far as we could learn, no antisyphilitic treatment. You will remember that the patient had a history of chancre about twenty years ago. This I regard as particularly instructive, in that it

shows how very frequently syphilitic aortitis is present even in patients in whom the blood Wassermann is negative, with or without a history of past lues.

Dr. Robbins has been good enough to preserve the specimens from the autopsy so that you see them here. The heart, of course, attracts our attention principally. There are one or two typical scars in the aorta about whose origin there can be no question. They are unmistakably syphilitic. The aortic valves show the principal pathology. You will see the intensely red vegetations and in one or two spots the ulcerations. You will note that one of the valves is perforated. This is the typical picture of an acute thrombo-ulcerative and vegetative endocarditis. The kidneys show the ordinary changes of a chronic diffuse nephritis, and I suspect that a histologic examination will show that there are some acute changes with these.

A second point of interest relates to the amount of fluid in the pericardium. About 6 or 7 ounces of bloody fluid were recovered from the pericardium, so our idea as to the amount of fluid was not far from correct.

CASE III.—SEROFIBRINOUS PERICARDITIS

December 20, 1916.

This patient is a schoolboy, born in this country of Irish-American parentage. He came into the hospital on December 11th and his complaints were four in number: First, sore throat; second, pain in the limbs; third, pain in the precordium; fourth, dyspnea which really amounted to orthopnea, as he was practically unable to lie down at that time. The trouble began a week before entrance with sore throat, and this continued up to the time of entrance. Then his legs and fingers began to hurt and feel numb. The pain in the precordium was sharp and constant and much aggravated by deep breathing. He was very short of breath, but was relieved a little by being propped up in bed. He had been up and about until two days before he entered the hospital, but since then has been very sick. There was no edema and he had not coughed up any blood.

Past History.—Last year he had a severe attack of articular

rheumatism associated with tonsillitis, and following that he had edema of the legs. He had been advised several times to have his tonsils removed, but the mother would not permit it.

Family history shows nothing of interest. His father and mother are living and well; three brothers and one sister are living and well.

Habits.—His bowels and urination are normal; his appetite has been poor since he has been sick and he has slept poorly since the onset of his trouble.

Physical Examination.—Inspection on entrance revealed a fairly well-nourished, anemic-looking boy who was evidently acutely ill and was moaning with severe pain.

Head and Neck.—The scalp was negative; the pupils were round, regular, and reacted to light and accommodation. The eyelids were slightly puffy. The cheeks were full. The tonsils were enlarged and showed plugs in the crypts. There was no tenderness or rigidity in the neck and no abnormal pulsations. There were some small lymph-nodes in the posterior triangle.

The *chest* was symmetric, the costal cartilages a little more prominent than ordinary. The lungs showed normal resonance, free expansion, no râles, and no areas of dulness.

The Heart.—The apex-beat was not visible and not palpable; no matter what position he was placed in, we could not see or feel the apex-beat. The right border of the heart dulness was $3\frac{1}{2}$ cm. to the right of the midsternal line; the left border was 1 cm. outside of the nipple line. No rounding of the cardiohepatic angle was present, and at that time no friction-rub was palpable.

On *auscultation* we could not hear any of the heart sounds because of a very loud to-and-fro friction-rub. It could be heard all over the precordium and was loudest at the lower end of the sternum. The pulse was regular, rapid and equal on the two sides, and of good tension.

The Abdomen.—The liver and spleen were not palpable and there were no points of tenderness. The genitalia were negative.

The *extremities*, particularly the fingers, tell an interesting story. The finger-tips are clubbed, the soft parts thickened, and they have a distinctly bluish, cyanotic appearance, this being the

condition which we see so often in old heart lesions. There is no edema of the feet. The reflexes are normal. The skin was hot and dry and at that time nothing abnormal could be seen.

The leukocyte count was interesting, 3400 white cells, of which 94 per cent. were polymorphonuclear neutrophils. The blood-pressure was 90 systolic, 68 diastolic. The urine showed nothing abnormal excepting a trace of albumin.

Diagnosis.—Now when we discuss this case we find the diagnosis, in a general way, fairly simple. We have a boy with a history of rheumatic infection coincident with attacks of tonsillitis. He was advised to have his tonsils removed because of his heart trouble, but this advice was not followed. He came into the hospital looking very ill, suffering very intensely, short of breath, the heart sounds obscured, and a to-and-fro friction-rub over the pericardium and a considerable rise of temperature—102° F.—with a pulse of 155 and respirations of 40. Since that time the temperature has varied from 99.5° up to 102.5° F., most of the time being around 100° to 101° F.

The diagnosis of pericarditis seems perfectly apparent, and I brought him up because, having recently shown you two other cases of pericarditis, I was anxious to show you this one of a little different type. On what, in a general way, is the diagnosis of pericarditis based? The simplest and most important feature is the pericardial friction-rub. The pericardial friction-rub is very different in its character, depending upon its age and upon the physical characters of the fibrinous exudate, that is, whether the latter is fresh and soft or old and leathery. When the rub is fresh it is soft, very much as if you were to take two pieces of velvet and rub them over each other. The important feature of these rubs is that they are not tied down absolutely to any particular part of the heart's cycle. I mean by that, that whereas an endocardial murmur, let us say an aortic insufficiency, occurs always at one phase of the cardiac cycle, the pericardial friction-rub does not. It may be at times systolic and at times diastolic. It may last almost entirely through systole and sometimes it remains all the way through diastole. At times it has a three-beat rhythm, probably due to the contraction of the auricles producing

an additional rub. The rub is due to the two surfaces rubbing against each other, and, naturally, if the patient changes his posture the rub will be different. If he lies on his stomach the two surfaces will have a different relation to each other than if the patient were lying on his back. I regard these as the most important things in the differentiation between an endocardial murmur and a pericardial friction-rub, especially the fact that the endocardial murmur always occurs at one part of the cycle and the pericardial friction-rub occurs at different phases. It sometimes starts a little sooner and sometimes lasts a little longer. Only in the very beginning of a pericarditis is the rub purely systolic, and, in my experience, not often then.

In the text-books very indefinite instructions are given as to how to tell an endocardial murmur from a pericardial friction-rub. If you hear a pericardial friction-rub and turn the patient over you may find that it will vary in tempo as it varies in time. The harder you try to fix and identify it with any particular phase, the less successful you will be. It does not come at all in nice, graded intervals. This patient has one of the most typical pericardial rubs that you can imagine. You might listen to two heart cycles and think it was a very rough endocardial murmur, but if you listen to the third or fourth you are at once convinced that it is a pericardial friction-rub.

Pain is supposed to be one of the most prominent symptoms, and it should be. When such a delicate organ becomes involved in inflammation and the two surfaces start to rub over each other it should produce exquisite pain, but in many cases no pain at all is complained of. I should say that the majority of cases do not have much pain, although statements vary in this respect. When pain is present its location is rather interesting. In most cases it is very simple—the pain being right over the precordium. We may have, owing to the fact that various nerves are sensitized, symptoms referable to other organs. Thus we have singultus when the phrenic is involved. Hoarseness or even aphonia may occur if the recurrent laryngeal be affected.

Sometimes the rub is very easy to hear and sometimes very difficult. If the two inflamed surfaces are on the back of the

heart it may be very difficult to hear. I have seen cases where we have suspected fibrinous pericarditis for several days before we succeeded in hearing a rub, and in these cases the inflammation probably originated on the posterior surface. When the involvement begins on the anterior surface the rub seems right under the skin. I should say that that was rather characteristic as compared with an endocardial murmur. The endocardial murmurs generally sound deep and the pericardial rub sounds superficial, but I have learned to rely upon the fact that the pericardial rub does not stick to any one phase of the cardiac cycle rather than anything else. As long as the surfaces are in contact we can elicit the rub, but if the process goes on and produces much fluid the rub may disappear, or, as frequently happens, both may be present. Even with considerable amounts of fluid we may still be able to get a pericardial rub over the anterior surface. The fact that you hear a rub means that no fluid is separating the surfaces at that point, but I have been able in many instances to hear a rub over one portion of the heart and get a moderate amount of fluid by aspirating in another area.

In this case there has been a great deal of difficulty in locating the apex-beat; in fact, we have not been able to get it so far, and that led us to say that there must have been a small amount of fluid in the pericardium from the very beginning. A very important thing is to be able to know where fluid first accumulates. The heart is a rounded body and bears a close relationship to the pericardial sac. We always make the examination with the patient lying on the back, and if there is fluid in the angle made by the upper border of the liver and the heart one can readily recognize it. There is normally an acute angle at that point, but when fluid begins to accumulate it pushes up the lung, and one of the first places for fluid to show itself is in the cardiohepatic angle. The next place is up along the left edge of the sternum. When we get a dulness in that area it should always make us think of the possibility of fluid. I do not mean that fluid accumulates there to begin with, because it always accumulates in the posterior portion to begin with, but it can first be percussed out at one of these two points.

Just as soon as fluid accumulates sufficiently so that it spreads out and comes up to the apex-beat, just that soon the apex-beat disappears. You can frequently recognize fluid in the cavity, particularly by means of the *x*-ray while an apex-beat is still present, so you must not expect to find in small amounts of fluid a disappearance of the apex-beat. Sometimes the apex-beat lies behind a rib, and in seeing a patient for the first time you can't be certain whether he has had an apex-beat or not. In the cases

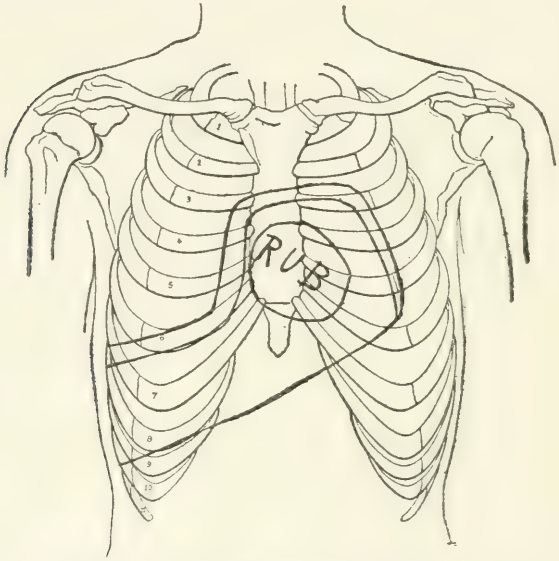

Fig. 151.—Serofibrinous pericarditis. Note that there was no sign of an apex-beat. The amount of fluid in the pericardial sac is quite moderate. The friction-rub is loudly heard over a considerable area. These were noted on December 11th.

where there is a fair amount of fluid we find the apex-beat, if we find it at all, the width of two fingers, or perhaps even more, inside the left margin of the area of dulness, which simply means that the dulness of the fluid goes out an inch or two beyond the apex-beat. That is just as characteristic of the fluid stage as the pericardial friction rub is of the dry stage. As the fluid becomes very pronounced the sac takes on the usual pear shape. We will find in some cases a large area of flatness over which we may hear al-

most no sounds at all. The disappearance may be due to two things: In the first place, you may lose the sound by reason of the very loud scratching sound made by the pericardial rub; and, in the second place, you lose the sound on account of the large fluid exudate.

Now how shall we interpret this case? The condition now is much as it was when he entered the hospital, except that the left

Fig. 152.—Serofibrinous pericarditis. Comparing this with the previous diagram, it is seen that the change in outline is most apparent near the region of the apex. The friction-rub is still audible over a considerable area. This outline was made four days after the last. Note that there is little rounding of the cardiohepatic angle.

border now extends about 1 inch further to the left than it did then. I think we can be quite safe in saying that there is only a medium amount of fluid. At the present time we can still hear the rub very well marked over the entire lower sternum and a little to the left of the sternum, and we can hear the heart sounds faintly at the position where we would expect the apex to be, so I think we are justified in saying that there is a moderate amount of fluid in the pericardium. Over to the right the cardiohepatic angle is

not obtuse, but along the left edge of the sternum, at the fourth rib, there is flatness for a distance of at least four fingers to the left of the left margin of the sternum. I feel, therefore, that in this case the fluid has shown itself more along the sternum than in the cardiohepatic angle, as the entire left border is at least 1 inch further out to the left than on admission.

With these typical physical findings, we have not much hesitation in saying that the patient has a serofibrinous pericarditis with exudate of moderate size. The thing that I want to impress upon you most is that pericarditis is one of the easiest things in the world to overlook. If the rub is double it is difficult to overlook, but if the rub is not double, or, owing to a collection of fluid, inaudible, a pericarditis is easily overlooked. In old people with more or less arteriosclerosis, when the heart dilates greatly the cardiohepatic angle becomes rounded and the apex-beat disappears, and in such instances a great many cases are called pericarditis, but are really dilated hearts.

The important thing is to think of *the conditions under which pericarditis develops*. To begin with, it develops in a certain percentage of cases of tonsillitis and articular rheumatism. We find pericarditis less frequently than we do endocarditis—that has been an observation for many years. Most cases of pericarditis have an associated endocarditis, but most cases of endocarditis do not have an associated pericarditis. I think this patient has an endocarditis, but we have not yet been able to demonstrate it.

The next most frequent cause of pericarditis is pneumonia. We can find it in any of the infections, but particularly with the rheumatic infections. Another common cause is chronic interstitial nephritis. For some reason or other that condition is particularly prone to produce a pericarditis. Often a case of interstitial nephritis which dies suddenly will show at autopsy a pericarditis which had been overlooked. This pericarditis is well understood and is quite characteristic, so that anyone who is taking care of a chronic nephritic should always be on the lookout for a pericarditis.

A very important point is as to the *nature of the exudate*. This is more important even than in cases of pleuritic effusion.

Is there a purulent or serofibrinous exudate? The great majority of rheumatic cases develop a serofibrinous and not a purulent exudate. Where a purulent exudate forms, the conditions are the same as in an empyema. The leukocyte count goes up and keeps going higher and higher, and the patient is very ill. One should always think of this in a pericarditis developing in the course of a pneumonia. This calls for a very prompt puncture, because only by a puncture can we tell what the nature of the fluid is. I believe a puncture of the pericardium should be done more frequently than it is. In a purulent pericarditis the case should be turned over to a surgeon and free drainage established. In a case where the temperature is up and down, especially if this follows pneumonia, an aspiration of the pericardium should be done right away, and if pus be found, drainage from a free incision should be at once instituted.

A good many places have been recommended as exploratory sites. I think that one should not always go in in the same spot. To begin with, we should not puncture at the point that we hear a pericardial rub because we know that the surfaces are in contact at that point. One should never go in where the apex-beat is to be felt, but if there is a well-defined dulness outside of the apex-beat one can go in there in the fifth interspace. If there is a considerable amount of flatness inside the nipple you can go in there, but this is not usually good practice. In my judgment this case does not warrant puncture because there is no suspicion of a purulent exudate, but if there were, I should aspirate in the fifth intercostal space just outside the point where we believe the apex is. If there is a large exudate you can aspirate in the fourth or fifth interspace just outside the sternum, and you will nearly always find fluid, but with small exudates you may get a dry tap. One should not hesitate to do a puncture the minute there is a suspicion of a large effusion. That calls for an exploratory puncture and immediate drainage. I am sure many cases could be saved if aspiration were done more promptly.

Treatment should be along the same lines as in pleuritis. The patient should be at complete rest, with an ice-bag on the heart part of the time, and in the rheumatic cases should receive large

doses of salicylates. I question the propriety of removal of the tonsils while they are in an inflamed condition. It is too likely to stir up serious trouble, but as soon as the patient gets over his pericarditis the tonsils should be removed if diseased. If the fluid does not promptly subside then there is nothing to do except to aspirate. When the fluid gets very large in amount it does not make much difference where you aspirate—probably any one of the spots named will be satisfactory. My advice is to remove only one-third or one-half the fluid, and in that way remove the pressure on the lymphatics and let nature remove the rest. It is not wise to remove too much at a time because of the tendency to cardiac failure. I have seen 2 cases die when a pleurisy was being tapped, but have never seen this happen in a pericarditis. The fluid should always be removed slowly and only partially. While the fluid in this case has not changed very much and the patient is still suffering, he is in better condition than he was. The clubbed fingers make me think that the pericarditis is a complication of an old endocarditis, but the rub is still so loud that we can't hear any murmurs. When the inflammation subsides we will probably be able to demonstrate a valvular lesion.

A number of drugs, such as sodium cacodylate, have been recommended in these cases, but I have not seen any special results from them, although brilliant results from the use of sodium cacodylate have been reported. I think there cannot be the slightest question in this case that the whole trouble had its origin in the tonsils.

I think it will be helpful if we consider briefly the conditions which exist in pericarditis, and see in what way these conditions affect the clinical signs. According to several investigators the normal pericardium is capable of holding approximately 200 c.c. of fluid without being abnormally stretched. When as much as 600 to 700 c.c. are injected, which can only be done by the application of considerable pressure, the result of this is that the heart is distinctly compressed. It is probable that such experiments do not represent the conditions as they exist in pathologic cases, in that a pericardium in an inflamed condition is probably more yielding to pressure than it would be in a non-inflamed

condition. If this were not the case it would be impossible for such large-sized exudates as are frequently met with, amounting sometimes to 2 liters, to develop, because the pressure on the heart would be so great as to produce a fatal interference with the circulation by pressure on the vena cava and the auricles.

A very important question relates to the relative positions occupied by the heart and the exudate. The older view represented the heart as acting in the same way as a relatively heavy body, and, therefore, sinking in the fluid exudate so that its ultimate position was close to the vertebral column. This view represented the fluid as collecting in large quantities between the heart and the chest wall. The existence of this fluid layer between the chest wall and the heart was generally supposed to be the cause of the weakening of the heart sounds which is so frequently present in exudates of any size. It has been shown experimentally that with two-thirds of a liter in the pericardial cavity there will still be an area at the base uncovered by fluid. The second view which has come into prominence in recent years is based upon the fact, which has been substantiated over and over again by clinicians, that the heart sounds and, indeed, the friction-rub are often plainly audible even with quite large exudates. I have personally seen a case in which, with over 2 liters of fluid obtained from the pericardial sac at autopsy, a friction-rub could be heard over a large part of the anterior surface of the heart. The patient died suddenly as we were preparing to perform paracentesis. It is then absolutely certain that in many cases at least the heart retains a sufficiently close relationship to the anterior chest wall to admit of the persistence of the friction-rub. It is possible that because of the peculiar motion of the heart in systole a rub may exist even though a thin layer of fluid intervenes between it and the chest wall, as von Schrötter maintains, but it certainly could not happen that a rub could persist if any considerable amount of fluid intervened. To my mind a very much more important argument is to be found in the contention of Curschmann. This author maintains that in a normal individual, especially where the anteroposterior diameter of the thorax is not excessive, the heart occupies practically all

of the space there is between the sternum and the vertebral column, especially in the middle line. In other words, the heart under normal circumstances occupies practically the entire space between these two bony structures, and hence there can be no possibility of its sinking to the bottom for the simple reason that there is no room.

To the right of the median line it is almost equally impossible for the heart to sink backward. On the left side because of the greater mobility of the apex this latter portion can sink back somewhat more, but still only to an inconsiderable degree. It is conceded, of course, that in cases where the thorax has an increased depth from front to back that the mobility would be greater. In my opinion this condition of affairs, where the heart lies in contact with the chest wall despite a very considerable exudate, explains why when a paracentesis is performed near the sternum it often results in a dry tap, when the autopsy reveals a fairly large-sized exudate. Of course I am speaking only of cases where there are no adhesions to prevent the free motion of the fluid. In support of Curschmann's contention, which has always appealed to me very strongly, let me urge another fact. A very considerable number of cases of pericarditis occur in patients who have endocardial lesions and who have, therefore, an enlarged heart. When the heart is larger than normal there is still less opportunity for it to sink backward, and hence under these circumstances one may expect the persistence of the pericardial rub.

The last word has by no means been spoken as to which of these views is correct. I have paid a great deal of attention to the matter, and my own feeling is that the latter applies more frequently, although I think the general consensus of opinion favors the older view. It is not in the least unlikely that both are correct, and that, with a small heart and deep thorax, fluid accumulates between the heart and the chest wall, and that with a large heart and a normal-sized thorax there is no chance for the sinking back to occur, and the heart, therefore, remains in contact with the chest wall, especially over the lower portion of the sternum. It is a notorious fact that a pericardial effusion is often found at

autopsy, where during life a pericarditis sicca was supposed to exist, because the friction-rub could be plainly heard. It seems to me that the explanation for this erroneous diagnosis is plainly given by the newer view.

From the clinical standpoint, and especially from the standpoint of treatment, it is very important to have a clear conception of what happens to the circulation when a steadily increasing amount of fluid accumulates in the pericardial sac. Animal experimentation has given us the clue to this. A small amount of fluid injected into the pericardium has for its first effect a rise in pressure in the vena cava, the aortic pressure remaining substantially unchanged. This rise in the caval pressure is sufficient to overcome the slightly increased pressure in the pericardium. The effects on the circulation are, therefore, negligible. A time comes, however, when if a small additional amount of fluid is injected the pressure in the pericardial cavity becomes distinctly greater than the pressure in the cava, and as soon as this happens the veins and the auricles, which are substantially dilated veins, promptly collapse. Starling has shown that this happens relatively suddenly. In the dog a given amount of injected fluid may be producing almost no effect on the circulation, and as little as 10 c.c. more may produce very serious interference with the circulation in the manner just described. In my judgment this is a most important fact, for it explains a tolerably frequent clinical phenomenon, namely, sudden death. It is highly probable that when severe syncopal attacks or sudden death occur in a patient who has not seemed especially sick despite a moderate-sized pericardial exudate, it is due to the sudden rise of the intrapericardial pressure above the pressure in the auricles and cava.

CLINIC OF DR. HERMAN L. KRETSCHMER

PRESBYTERIAN HOSPITAL

FULGURATION TREATMENT OF BLADDER PAPILLOMATA

Significance of Painless Hematuria. Value of Cystography in Diagnosis of Vesical Neoplasms. Selection of Cases for Fulguration Treatment. Technic and Results.

December 18, 1916.

BLADDER papillomata occupy a rather unique position in the field of genito-urinary therapeutics, in that their treatment has undergone a complete change; whereas formerly these patients were subjected to an open operation, at the present time the open operation is but rarely if ever carried out. The surgical treatment of bladder papillomata has been superseded by the use of the high-frequency cauterization, which can be carried out in the largest percentage of cases. Occasionally a patient may be seen in whom cystoscopy, for various reasons, cannot be carried out; or, on the other hand, the bladder may be completely filled with papillomata, so that intravesical manipulation cannot be performed. In this very small group of cases it becomes necessary to resort to suprapubic cystotomy and to treat the tumors by fulguration through the suprapubic opening, or under certain conditions one might be justified in performing a resection of the tumor with sparking of the base.

As an example of what may be accomplished by this form of treatment, even though the tumor may be very large, I should like to present this patient.

Mr. R. W. G., aged forty-nine years, a farmer, was first seen on September 26, 1916.

History of Present Complaint.—In April, 1916, the patient noticed for the first time that his urine was bloody. The hematuria was not preceded by any pain. The blood was always intimately mixed with urine. The first attack of hematuria lasted for three weeks, after which the blood disappeared from the urine. Since then the hematuria has been intermittent and it has always been painless in character and without symptoms. The patient was cystoscoped in his home town and a diagnosis of "stone in the bladder" was made. There were no other symptoms that might aid in making a diagnosis.

Physical examination was negative. Röntgen ray examination of his kidneys was negative. In the röntgenogram of the pelvis were seen many small round shadows that evidently were misinterpreted as being due to calculi; they are due to the presence of some shadow-producing bodies outside of the urinary organs, such as calcified lymph-glands, calcifications in the pelvic ligaments and muscles, plaques in the large pelvic vessels, etc. The diagnosis of stone in the bladder, previously made, was excluded by cystoscopic examination made at the time of his first admission to the hospital.

Cystoscopic Examination September 26, 1916.—The internal urethral orifice was negative. The left ureteral orifice appeared dilated. In the region of the right ureteral orifice was seen a papilloma the size of a lemon. The tumor completely covered the right ureteral orifice so that it could not be seen.

After the diagnosis of papilloma was made the patient was given his first treatment with the high-frequency current. The bipolar or d'Arsonval current was used.

October 12th.—The patient re-entered the hospital. A cystoscopic examination at that time showed that a large part of the tumor had been removed. The patient was subjected to another fulguration and instructed to return in two weeks.

October 29th.—Cystoscopic examination showed that the tumor was about one-third its original size. He received another high-frequency cauterization and was instructed to return in about two weeks.

November 2d.—The patient returned to the hospital for fur-

ther cystoscopic examination and treatment. The cystoscopic examination showed a mass of tumor about the size of a hazelnut situated behind the right ureteral orifice. This was the first time that the ureteral orifice could be seen. The patient was again subjected to a high-frequency cauterization and instructed to return about the middle of December.

December 18th.—The patient returns to the hospital for cystoscopic examination. This shows an area of ulceration about the size of a bean at the site of the former papilloma. The tumor has, therefore, been completely removed by the use of the high-frequency cauterization.

The history which the patient gives is significant because it is the history so often given by patients with bladder tumor. This man complained of a symptomless and painless hematuria. There were no other symptoms that would aid us in making our diagnosis. Hematuria, with a very few exceptions, usually means the presence of organic disease in the urinary tract. The importance of hematuria as a symptom cannot be too strongly emphasized, and it is most unfortunate that its importance is so often disregarded by both patient and physician. Instead of making an accurate diagnosis, vague and indefinite terms are used in describing the hematuria, and various so-called styptic drugs are administered, after which both patient and physician wait for the bleeding to stop. Of far more importance than treatment in this type of case is the necessity of determining the origin and the cause of bleeding in each and every case. With the modern methods of diagnosis the origin and cause of urinary hemorrhage can be ascertained in practically every case. It may not always be possible to do this at one examination, so that it becomes necessary to cystoscope these patients a second and even a third time, besides resorting to other methods of diagnosis.

The value of making an early diagnosis becomes apparent if you bear in mind the large number of cases of bladder hemorrhage which are due to tumor. If we expect to have a large number of operative cures we must make an early diagnosis in this group of cases. In a series of 86 consecutive cases of bladder hemorrhage, 32 cases were due to carcinomata and 26 were due to papillo-

mata; it will be seen that about three-fourths of all bladder hemorrhages are due to tumor formation.

The treatment of papillomata of the bladder by the open operation has always been a very unsatisfactory part of urinary surgery. It is a well-known fact that the tendency of papillomata is to recur after operation in a large number of cases operated upon, this recurrence having been variously estimated to be as high as 50 per cent. Not only do they recur at their former sites, but new tumors are often found in parts of the bladder remote from the site of the former operation, and they have often been known to recur in the operative scar. If we add to the possibilities of recurrence the possibility of malignant degeneration in the tumor as well as its recurrences, the dangers of anesthesia and postoperative complications, and if we consider the poor surgical risks in those who have had profuse hemorrhages, the outlook for an ultimate cure by the open operation is, indeed, bad.

The results of the fulguration treatment of bladder papillomata, however, have been so uniformly successful that modern urinary surgery absolutely demands this form of treatment in these types of tumors. Nothing has so stimulated the general interest in this subject as the use of the high-frequency current.

Technic.—The patient is prepared for cystoscopic examination, the bladder being distended with boric solution. The operating cystoscope is passed into the bladder and the fulguration catheter is introduced through the catheterizing channel into the bladder. The tumor, or one of the tumors if there are multiple growths, is located and the catheter passed forward to the tumor. The method of applying the current is variable; one may plunge the catheter directly into the substance of the tumor or one may leave a small gap between the end of the catheter and the growth. I have carried out this procedure in both ways. It does not seem to make much difference in the results which method is employed.

Two types of current may be employed, the unipolar or Oudin and the bipolar or d'Arsonval. If the bipolar current is

used, one pole is connected with the fulguration catheter and the other terminates in an electrode, the placing of which depends on the location of the tumor. If the tumor occupies the base of the bladder, a large flat plate may be placed under the buttocks. If it occupies the upper wall of the bladder, the plate may be placed over the suprapubic area.

Selection of Cases.—Of prime importance with this, as with any form of treatment, is the fact that its success depends upon a careful, judicious selection of cases. It has been pretty definitely established that this form of treatment is the treatment par excellence for benign papillomata. The result in frank malignant disease of the bladder has not been at all satisfactory, and it is better not to subject malignant cases to this form of treatment.

At times it may be difficult to differentiate between malignant and benign tumors. In order to determine definitely the nature of the tumor it has been suggested that a small piece of the tumor be removed for histologic study by means of an operating cystoscope. There have been many objections to this sort of procedure, it having been condemned by many as being not only unsatisfactory but positively dangerous.

In order to determine whether a tumor is benign or malignant I thought it might be well to subject the doubtful cases to cystography, thinking that one might differentiate benign from malignant tumors by noting a filling defect in the cystograph. In advanced carcinomas this is possible; in the early cases it may not be. We have noted in several instances that the tumor on histologic examination showed malignant change at the periphery, whereas the *base* had not undergone change. Hence there was no infiltration of the bladder wall and a normal cystograph was obtained. It must also be borne in mind that there are many other pathologic conditions besides carcinoma that produce filling defects.[1] In doubtful cases we have resorted to histologic examination of small pieces of the tumor removed with the aid of a cystoscopic rongeur. Formerly we attempted to study the pieces of tumor obtained at the time of fulguration. In most cases this

[1] Kretschmer, "Cystography. Its Value and Limitations in Surgery of the Bladder," Surgery, Gynecology, and Obstetrics, December, 1916.

was unsatisfactory, as the pieces obtained were so thoroughly charred as to be wholly unsuited for histologic study.

Treatment of Recurrences.—It was formerly believed that the recurrences following the open operation were due to inoculation and the result of faulty technic especially due to careless wiping with sponges; that this is not always true is evidenced by the fact that recurrences have been found in that part of the bladder wall which had been covered by the retractor. If the so-called recurrences are seen at the site from which the tumor was removed one may consider them as being true recurrences. Not infrequently, however, one sees these so-called recurrences in parts of the bladder remote from the primary growth, and the site from which the primary tumor was removed is free from neoplasm. If one is dealing with such a case it is questionable whether it can be called a true recurrence because cystoscopically there is no tumor at the site from which the former growth was removed. Under such circumstances one should look upon these as true new tumors.

Element of Pain.—This depends upon the pain incident to the necessary instrumental manipulation and is variable. Many patients are cystoscoped without any pain or reaction and other patients suffer a great deal. The pain due to the treatment proper is practically nil as long as the high-frequency current is applied to the periphery of the tumor. The only part of the treatment which has produced pain has been toward the end of the treatment when most of the tumor has been removed, so that only its base remains to be treated. It is not uncommon for patients to complain of pain while treating the base of the tumor.

Where Treatment Should Begin.—To which portion of the tumor should one begin making applications? In small growths there is but one course to pursue, and that is to begin at the periphery. Small papillomata if they are thoroughly sparked require one or two treatments for their complete removal. In very large growths one may apply the current directly to the pedicle of the tumor in an attempt to sever the tumor from its pedicle. Where this procedure is successful it accomplishes at one sitting the same end that would require numerous treatments if the ful-

guration was started at the periphery. This procedure, however, cannot always be carried out owing to the difficulty of locating the pedicle. With a similar object in view one may remove the bulk of the tumor with a snare or with a cystoscopic rongeur. After most of the tumor has been removed in this way the remnant may be treated with the high-frequency current. In large tumors where this is not carried out one begins the high-frequency cauterization at the periphery of the tumor. When the high-frequency cauterization is working properly there are several phenomena which may be noted through the cystoscope. When the current is on, small bubbles of gas may be seen emanating from the end of the catheter. These gas-bubbles sometimes make a small report. At the same time the tumor undergoes certain changes. It becomes altered in character so that it no longer resembles a papilloma. The tumor becomes white and looks necrotic. During the next week or ten days these necrotic particles slough off and are voided by the patient. When large areas of tumor slough away patients sometimes have rather sharp bleeding which may last during several voidings.

Number of Treatments.—As an average three or four fulgurations have been enough to cause the average tumor to completely disappear. However, the number of treatments must vary, depending in part on the duration of each individual sparking. In the tolerant patient one may often accomplish more in one or two sittings of long duration than in half a dozen or more fulgurations of short duration in the intolerant patient.

Complications.—This form of treatment has been remarkably free from complications. The hemorrhage that occurs after fulguration when the tumor sloughs off can hardly be considered of much moment and, as far as I know, has never been serious. An interesting fact in connection with this form of treatment is that the cases reported in the literature have all been free of complications. I have not been able in a recent review of the literature to find any untoward result recorded in the literature at my command. This speaks well for this form of treatment, especially when one considers that the reports of the results of a new method of treatment are recorded from men in all sections of the country.

Local Reaction.—As a result of the application of the high-frequency current there occurs a certain amount of local reaction in the wall of the bladder. This local reaction seems to vary, being more marked in one patient than in another, and it seems to be more marked when one is treating the base of the tumor. This local reaction often may resemble and be mistaken for carcinoma. This fact should be borne in mind not only when treating our own cases, but when treating patients who give a history of having been fulgurated elsewhere. This reaction usually disappears in a week or ten days without anything being done. Cases have been reported in the literature in which this reaction was mistaken for carcinoma and a resection of the bladder carried out.

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PARALYSIS AGITANS

Demonstration of Three Patients with Characteristic Symptoms of Parkinson's Disease. Peculiarities of the Tremor and the Reflexes. Pathologic Changes in the Lenticular Nucleus. Differential Diagnosis from Wilson's Disease, Multiple Sclerosis, Pseudobulbar Paralysis, and Paresis. Treatment.

October 20, 1916.

TODAY I want to talk to you about Parkinson's disease, paralysis agitans. This has been known as a disease entity for about a century, being first described by an Englishman named Parkinson. The descriptive name, paralysis agitans, signifies a paralysis with agitation or with uncontrolled movements. The essential symptoms are a very slow tremor and a resistance to voluntary movements due to increased muscle tonus or inco-ordinated muscle tonus. This is merely another way of saying "paralysis." These two fundamental disturbances, the tremor and the resistance to movements, entail other symptoms and require further elaboration.

I wish to speak especially of the fact that many of these patients show other symptoms and differ in the way the fundamental symptoms show themselves. These differences occur in a manner that leads us to feel that this is not a disease entity in the sense that tuberculosis or typhoid fever is a disease entity, but rather that the symptoms which we group together under the name of paralysis agitans are due to a diffuse involvement of a certain part of the brain, which is essentially chronic and destructive, with perhaps a certain amount of irritation as well as destruc-

tion, differing greatly in different patients in cause, spread, and intensity.

You will remember that symptoms from the side of the nervous system depend largely upon whether they are due to an irritating lesion or a destructive lesion.

To go a little afield, syringomyelia—which is essentially a disease of the spinal cord—is characterized by the overproduction of glia followed by destructive processes in this glia. In syringomyelia the glia about the central canal of the cord is proliferated. It tends to collect into groups or rosettes. The centers of these rosettes widen out or break down in such a manner as to form the beginning of what you might consider new central canals (illustrating on blackboard). This process goes on especially in the ependyma of the central canal with the eventual formation of a large central cavity. A similar condition is also found in gliomata of the brain. It is known that the ependymal cells are of the same species as glia. It is the nature of ependymal cells to have one side of their cell body border on a canal, and as likely as not it is that property of glia cells which leads to the formation of these small holes in the central nervous system. I have a pathologic specimen from a man who had a diffuse proliferative lesion in the spinal meninges and glia. It led to a syringomyelia in the spinal cord. In the cerebellum we find the same overgrowth, and in the center of groups of glia these small canal-like spaces are present.

In some cases of paralysis agitans there is an apparent overgrowth of glia in a certain part of the brain. This part of the brain is the lenticular nucleus or corpus striatum. The internal capsule, through which run fibers having to do with voluntary activities, runs very close to the lenticular nucleus. When we find structures close together in this way we usually find some relationship between their functions. The internal capsule carries the pyramidal tract which has to do with voluntary activities whose success is dependent upon a certain tonicity in the muscles. It is supposed by some men that the lenticular nucleus has some controlling function over this tonicity so that when destruction or irritation occurs in the lenticular nucleus we get dis-

turbance of the tonus of muscles. When glia overgrowth occurs we have a right to expect the formation of these little cavities. Such cavities have been described in paralysis agitans. They have been held to be due either to glia activity or to an enlargement of perivascular spaces about the blood-vessels. In recent years the evidence has gradually accumulated that the lenticular nucleus and its dependent structures are the parts most affected by the disease process in paralysis agitans. The muscles were examined and found normal; the peripheral nerves and spinal cord were found normal; the cortex was found normal; the midbrain and red nucleus were found normal in the vast majority of cases. Consequently, the basilar ganglia have been extensively investigated in later years. This study has finally led to a mass of evidence pointing toward disease of the lenticular nucleus, and that disease of a nature suggesting an overgrowth of glia.

In 1912 Wilson, of London, described the disease known as progressive lenticular degeneration, in which cavities were found of a very large size. In Wilson's disease is found a tremor which is almost a duplicate of the tremor of paralysis agitans. It is of essentially the same size and involves the same muscles, but it is different in this sense from the ordinary classical tremor of paralysis agitans that instead of being diminished by voluntary motion it is rather increased thereby. In Wilson's disease there is no question but that the lenticular nucleus is the source of the trouble because of the very large macroscopic cavities found on section of the brain.

Paralysis agitans is a collection of symptoms evidently due to disease in the lenticular nucleus, in many cases showing this glia formation. Ramsay Hunt, at the last Congress of Neurologists, exhibited some very good photographs showing undoubted changes in the lenticular nucleus. What I wish particularly to impress upon you is that in some cases there is very evident glia proliferation and degeneration; in other cases there seems to be merely a destruction of the ganglion cells by some toxic agent, but in all cases the disease is in the lenticular nucleus. If you appreciate these facts it is not difficult to see why different cases will have a different symptomatology. For instance, changes in the

reflexes may be due to the disease getting into the pyramidal tract.

In the classical description of the disease the presence of a Babinski sign is not mentioned. Before this conception of the disease that I am speaking of was held, a Babinski was explained when present as being due probably to the fact that the extensor muscles of the great toe were stronger than the flexors. Now we would say that the pyramidal tract is involved and that it is a true Babinski sign.

Case I.—This patient is thirty-two years old. Her disease started when she was seventeen. Parkinson's disease has always been considered a disease of middle age or old age. Consequently, this particular case was considered as probably not Parkinson's disease. Her knee-jerks are very much increased; the wrist-jerks, especially the left, are markedly increased. Although there is the marked increase in the knee-jerk there is no ankle-clonus; the ankle-jerk, on the other hand, is quite brisk, and here is a point which leads to some confusion. This leg is in a certain condition of tremor at the present time, and when I bring out the ankle-jerk as the foot tends to go back into position, the tremor agitating the calf muscle gives the impression of a clonus. This impression is due to the tremor in the calf muscle rather than a true clonic state, or it is possible that the tremor and the clonic state may have the same underlying cause.

Case II.—In this case you can see the same brisk knee-jerks and what looks rather like an ankle-clonus, but it is on the same basis as in the previous patient. It is the tremor in the lower leg muscles rather than a real clonus. The ankle-jerk is about normal on both sides. The plantar reflex is normal. You can see the little tremor which is agitating his hand as it lies at rest. There is also a little tremor of the thumb as it lies against the first finger. As you see, the tremor in the right arm is made worse as he walks. Every once in a while when he relaxes some part of his body the tremor appears in his hand. You can notice the peculiar position of his head and that there is no swinging of his arms as he walks. The head is bent a little forward, the body is held very carefully balanced over the center of gravity.

There is no nystagmus, there is some tremor of the tongue as he protrudes it; both as he shows his teeth and shuts his eyes there is a little tremor in the face, and as he shuts his eyes a little trembling about the mouth. The first patient had this same symptom. As he raises his right hand it is perfectly steady, but as he drops it there is the tremor. As long as he tries to do a thing voluntarily there is no tremor, but as soon as the act is finished the tremor returns. We see this early in the disease and it will often escape notice if not looked for carefully. Almost every case of paralysis agitans that I have ever seen showed a tremor as the patient sat down or relaxed after holding himself erect. There would invariably be some little tremor somewhere, of the head, the arms, or the legs. It often helps greatly in the diagnosis to watch these people walk and then sit down. To see them change from a state of tonus to a state of relaxation will often bring out the little tremor when you won't see it at any other time. In one case in my service at Dunning, which lasted about four years, the patient had practically no tremor until the last two or three months of his life in the way that most cases of paralysis agitans show a tremor. But even when he first came to the hospital he showed this little tremor when he would get through with a voluntary motion and start to relax. He had another symptom which is sometimes shown, namely, an extremely oily skin. This man has it to a marked degree; my fingers are covered with oil as I rub them over his face.

Case III.—This is a more characteristic case in that the tremor is perfectly typical, the age is the age which we expect in paralysis agitans, and there is the characteristic position. In this man the disease is further advanced. I want you to bear in mind the peculiar fixed position, in walking, of the first two patients—everything held steady except the legs, the fact that they were bent over slightly, and the very careful manner in which they carried themselves.

In this patient we find the right knee-jerk is about normal, the left is usually a little increased. It is very difficult to demonstrate deep reflexes in this condition of abnormal tonus, but I think you can see that the left knee-jerk is distinctly more brisk

than the right. The ankle-jerk is present, but not marked. The plantar reflex, on the contrary, is atypical. It is a dorsal reflex. I want you to notice that the tendon of his great toe makes a ridge on the dorsum of his foot. The toe is pulled up and the tendon is very prominent, and what movement we get from plantar irritation is in a dorsal direction. The same condition relative to the tendon of the great toe is also very prominent on the left foot and the toe is held constantly in a slightly dorsal position. When we apply a light stimulus to the foot sole it looks almost as if there was plantar flexion, but when we apply a heavy stimulus there is a dorsal flexion. The deep reflexes elsewhere are practically normal. At the beginning of a movement there is cessation of tremor all over, and then as the movement goes on the tremor gets worse and worse in the part that is at rest.

I wanted to show these three patients together so that you could get the appearance of the three firmly in your mind. I know of nothing except hysteria that can successfully imitate this disease. You see the tremor is just about the same in the 3 cases; it is not the large tremor of multiple sclerosis. Also, there is the same appearance of the face in all three patients: the sort of fixed expression which is present and is one of the pathognomonic signs of Parkinson's disease. This mask-like face is also seen in pseudobulbar paralysis, which is due to disease on both sides of the brain involving or impinging upon the internal capsule. In other words, it has much the same pathologic substratum as Parkinson's disease.

To take up the histories: The first patient is now thirty-two; her trouble started fourteen years ago as a dragging of the left foot, as she says, because of clumsiness. The tremor started first in the left arm. The dragging of the foot is probably an evidence of the resistance to voluntary motion which I spoke of as one of the two fundamental phenomena. The tremor has always been a tremor of rest; when the hands are quiet the tremor is apt to appear, but when she puts her hands to work it diminishes. This symptom grew gradually worse, and three years ago she noticed a numbness in the right arm. The rigidity of the muscles has been persistent all the time, but when she thinks

about this rigidity it becomes much less marked. It is a characteristic thing in paralysis agitans to see the tremor all over the body stop just as a motion is started, and as soon as the motion is well under way the tremor tends to appear in other parts of the body than those which are being used for voluntary motion.

There is nothing particular in her family history. Three sisters and her parents are in good health. She had appendicitis at the age of nineteen, scarlet fever at the age of thirteen. That may have been of some importance, but I will take up that question when we come to the etiology of this disease. The probability is that these changes in the lenticular nucleus are caused by toxins of some sort or other, and with our growing ability to discover the toxicity of different agents we are coming to think more and more of microbic origin of different diseases.

Her heart and lungs are normal, the superficial reflexes normal, the patellar reflex is exaggerated and has been ever since she has been under observation; there is the suggestion of ankle-clonus on the left side which, as I said before, I believe is due to the tremor rather than to a true clonus. There is no Babinski, no Oppenheimer, or Chaddock sign. The eye-grounds are normal.

This is an enlargement of a tracing of her tremor (illustrating on blackboard) and shows the amplification and decrease of the excursions. The tremor goes in waves, starting very small, gradually becoming larger and larger, reaching an apex, then gradually diminishing; each wave showing eight to ten tremor movements. The tracing is just such as is obtained in Cheyne-Stokes respiration.

The second patient is now thirty-eight years of age. He was healthy up to a little more than a year ago. His mother died at sixty-one of paralysis, his father at sixty-five of "old age." One brother was accidentally killed, one is living and well; five sisters are living and well. He does not use alcohol. He has a wife and child living and well.

There is a rather good description of his clinical condition written in the history: "His attitude on standing is with the head dropped and the eyes cast downward. His gait is slow and hesi-

tating, spastic, with a dragging of the left leg. His face lacks expression. The eyes move without any particular nystagmus; the pupils are equal and regular, the fundi negative. The tongue is smooth, like glass to the touch. The saliva unconsciously runs out of the right corner of his mouth. His deglutition is difficult, as he cannot turn his food with his tongue easily. His speech is slow and scanning, indistinct, and slightly nasal." The tremor is described as an intention tremor, but I have never been able to satisfy myself that the tremor was intention; it is a tremor of rest. When he starts to get up he has no tremor; as he touches his finger to his nose he has no tremor, but as he lets his hand down or when he sits down the tremor appears. If he thinks about the rigidity it disappears.

December 27, 1916.

You will remember that at the last clinic hour we discussed paralysis agitans and I showed you 3 cases—the girl of about thirty, whose trouble began when she was seventeen; the man of thirty-eight, whose trouble began at thirty-seven; and the old man of sixty-five, whose trouble began at sixty. There were certain things that were common to all 3 cases.

Perhaps the most striking thing to the casual observer was the attitude of the three patients—the way in which they held themselves rather rigid, bending somewhat forward when they started to walk, with the shoulders drooped. This was especially marked in the middle patient. The gait of all three patients was very similar; the arms were rigid at their sides. It was common to all of them that their faces were mask-like and did not change readily in expression. The third thing, although it differed greatly in degree, was the tremor. The girl had a very marked tremor. As she stood quiet the tremor was quite apparent in her hands; the younger man showed the tremor when he would release his arms after having made a voluntary movement with them; the old man had the tremor all the time. These general characteristics were common to the 3 cases.

They differed from each other in the manifestations from the side of the pyramidal tract. The girl had very much exaggerated deep reflexes. The patellar reflex was distinctly exaggerated, and

there was a suggestion of an ankle-clonus on the left side which, however, might be attributed to the tremor. The younger man had increased reflexes in the ankles, the knee-jerks were increased, the reflexes in the arms were brisk, but not exaggerated. The reflexes in the old man showed the ankle-jerk on the right side distinctly diminished and the left somewhat diminished. The knee-jerks were approximately normal, the left a little more brisk than the right. The reflexes in the arms were all diminished and all about equal. There was a Babinski on the left and a suggestion of one on the right. The deep reflexes have always to be considered somewhat in conjunction with the superficial reflexes. The frequent combination in cases where the pyramidal tract is involved high up is: the deep reflexes increased, the abdominals and the cremasteric diminished. In the girl the abdominals were normal. In the younger man the right abdominal was normal, but the left was diminished. In the old man the abdominals were diminished on both sides.

Differential Diagnosis.—I spoke a little about the differential diagnosis so far as the general characteristics of Parkinson's disease were concerned, namely, the increased tonicity on both sides of the body. We see increased tonicity in two or three other diseases—in multiple sclerosis, in pseudobulbar paralysis, in Wilson's disease, and in rare conditions, such as bilateral tumors, hydrocephalus, and things of that nature. We can eliminate hydrocephalus in these 3 cases without much difficulty. As to the more common diseases, for instance, multiple sclerosis, that disease not only has the increased tonicity, but it also has a tremor as one of the pathognomonic signs. But the tremor of multiple sclerosis is a characteristic intention or volitional tremor in type, the exact opposite of this disease. In multiple sclerosis the tremor appears when the patient voluntarily moves his arms or hands, and it can also be demonstrated in the legs. The tremor of multiple sclerosis is intentional, volitional, whereas that of paralysis agitans is a tremor of relaxation or rest. Another characteristic difference in the tremors is that in multiple sclerosis the tremor is of large amplitude and in paralysis agitans it is of small amplitude. Also in paralysis agitans it is a tremor of wave-like character: it

works up to the maximum and then diminishes, increases again, and so goes on for hours. On the other hand, the tremor of multiple sclerosis begins as a volitional movement begins, then slowly gets larger, right up to the end of the movement. If they attempt to touch the end of the nose with their finger they will start with a very little tremor, but by the time they get to the nose the tremor is very large. Then if they can get the finger on the nose and can exert pressure the tremor will get less, while just the opposite is true in paralysis agitans. The tremor of multiple sclerosis involves the whole extremity, whereas in paralysis agitans it may be confined to a small group of muscles such as those of the thumb and index-finger.

The tremor in Wilson's disease is a combination of the two. It is a tremor of rest which is increased when volitional movements are attempted.

There are focal lesions occurring about the origin of the red nucleus in the subthalamic region which produce tremor which is almost the duplicate of that of paralysis agitans, but such disturbances are almost always associated with disturbances of the ocular nerves because fibers of the third nerve run right down through the red nucleus.

There is one other condition which has to be differentiated from paralysis agitans, and that is general paralysis of the insane. That has to be considered in these 3 cases especially. It is always due to syphilis and we invariably get positive Wassermann reactions. This old gentleman has a positive Wassermann and a history of syphilis which was acquired twenty-seven years ago. The tremor of paresis is rather a slow tremor which is quite similar to the tremor of paralysis agitans except that it has not the wave-like appearance of paralysis agitans; it is not "pill rolling" in character. The tremor of paresis is a tremor of volition as well as rest. It is most frequently seen around the lips and lower jaw, where it gives a tremulous aspect to the face; the tremor of paralysis agitans very rarely involves the facial muscles. It is a tremor of rather smaller amplitude than that of paralysis agitans. Of course, in paresis you get the concomitant symptoms of cerebrospinal syphilis, for instance, the Argyll Robertson pupil.

In its purest sense this is a very small pupil, a myotic pupil. The term Argyll Robertson has been applied rather to the reaction of the pupil than to its size, so it is better to say that in paresis you get the Argyll Robertson reaction of the pupil, namely, the reaction of contraction to convergence with a failure of reaction to light. In one case of paralysis agitans I have seen myotic pupils; the man died, and on necropsy we did not find the typical gross signs of paresis in the brain. No microscopic examination was made. His spinal fluid was always negative. He had the typical mask-like face and the typical tremor. The pupils were so small that it was impossible to see whether there was any reaction to light or not. He had some cerebral irritation that produced the myotic pupils, but whether it was of a syphilitic nature or not I do not know. In paresis, also, you get the history of convulsions, of little temporary aphasic attacks, of transient attacks of diplopia, and a history of bladder and rectal disturbance. The bladder and rectal disturbances occur to a less marked degree in Parkinson's disease. In paresis there is a peculiar condition which helps to differentiate it from paralysis agitans and that is an anesthesia of distraction. If you get a paretic engaged in conversation you can stick him with a pin and he will pay no attention to it, whereas if you get his mind fixed on the test he will be able to tell the head from the point very well. In a woman with myotic pupils, whom I saw the other day, this worked out beautifully. I put a pin in the ankle and left it there and she paid no attention to it at all, and when I wanted to do a lumbar puncture I did it without any complaint on her part, and yet when I called her attention to the test she could differentiate sharp and dull every time. Afterward we found she was taking morphin, which, of course, accounted for the condition.

The variations of the symptoms in Parkinson's disease are many. The degree of the involvement of the face varies in different conditions. It is always more or less present. In some cases it may take a trained observer to recognize it, while in other cases it is very apparent. As I said, the disturbances of the bladder and rectum are not at all uncommon in Parkinson's disease. In all probability they are dependent upon the same pathologic

foundation as in pseudobulbar paralysis. As you know, pseudobulbar paralysis is due to a lesion on each side of the brain which involves to a certain degree the pyramidal tracts. Usually that lesion is a rather small one. It is necessarily a small one because it has allowed the patient to go on living. It is usually due to thrombosis rather than to hemorrhage. It requires arteriosclerosis as an etiologic factor. Of course, arteriosclerosis can occur on a syphilitic basis in the young, but the vast majority of cases of pseudobulbar paralyses we see in the old, and for that reason it must be differentiated from Parkinson's disease. In pseudobulbar paralysis the most typical cases always give a history of two strokes, one for each side of the body. You get a tremor which is a tremor of old age—a nodding tremor of the head, a tremor which is comparable to the tremor of weakness. It is not essentially the tremor of rest, although it is present during rest. In pseudobulbar paralysis you get a mask-like expression of the face, markedly increased reflexes, with bilateral Babinski signs. You also get a disturbance of the bladder and rectal functions. The gait of pseudobulbar paralysis is a spastic gait with very short steps, whereas the gait of paralysis agitans is essentially a sort of a falling gait. In pseudobulbar paralysis the scraping comes at the beginning of the step, whereas in paralysis agitans the scraping is at the end of the step. In pseudobulbar paralysis you can find evidences of arteriosclerosis at other points in the body.

Now why do we in multiple sclerosis, in pseudobulbar paralysis, in Wilson's disease, and in Parkinson's disease get these same symptoms—a little bit different in each disease, but nevertheless present in all of them? That is what led men to search in the brain for the typical lesion of Parkinson's disease, and that is the thing I want to bring out. In all probability the lesions of the different diseases are in the same locality in the brain, that is, in multiple sclerosis in all probability the lesions which produce the tremors and the spasticity and the general appearance of increased tonicity are in the lenticular nucleus, the corpus striatum of the brain. The lesions of Wilson's disease are essentially of the lenticular nucleus. The lesions of paresis are diffuse through-

out this region as well as in other places, and I think it is a fact that the lesions which are present in this locality cause the similarity in the disease pictures in some instances. In pseudobulbar paralysis the lesions are essentially in the same neighborhood where we now suppose those of Parkinson's disease to be.

Treatment.—In Parkinson's disease there is practically no treatment so far as curative results are concerned. At least we have not discovered anything as yet. If we go on the basis that these conditions are due to microbic invasion we are bound to search out any focus of infection that we can find. That is true of Parkinson's disease as it is true of multiple sclerosis and of paresis. Of course, in paresis we have decided that the focal disease is syphilis. In multiple sclerosis Rosenow has isolated the streptococcus from the tonsil and has injected it into animals and produced typical multiple sclerosis. The course of multiple sclerosis suggests the sending forth of flocks of bacteria into the circulation. It comes on suddenly, will get a little better, and then there is a recrudescence, and then they get a little better again, and so on down to complete disability. It seems as if at one period a small army of bacteria had been sent out into the central nervous system, which has adjusted itself and gone along until another flock of bacteria was distributed. In paralysis agitans, as in multiple sclerosis, we must search out any focus from which poisons can originate so as to get into the central nervous system and produce symptoms.

So far as the tremor is concerned, the most disturbing factor of the disease in the early stages, it is fairly well controlled by hyoscin. Hyoscin by mouth is just about as effective as when given hypodermically. It is used in doses of $\frac{1}{200}$ grain three times a day by mouth, increased to $\frac{1}{150}$ or $\frac{1}{100}$ grain if not sufficient. Sometimes they can get along fairly well on $\frac{1}{200}$ grain twice a day, and they will go along for months before you have to increase it. Atropin is used in doses up to $\frac{1}{25}$ grain. It, however, has the unpleasant symptoms of dryness of the mouth and dilatation of the pupils when used in large doses to control the tremor. Duboisin and scopolamin are also used in approximately

the same dose as hyoscin; hyoscin, however, is much the best of the drugs.

A régime of firm habits sometimes helps these people greatly, especially when they have trouble with their bladders, as a good many of them do. To make a rule that they shall go to the toilet every two or three hours will sometimes get them into a habit of emptying their bladder in a way which will increase their comfort greatly. As a rule they do not have much difficulty about sleep; they sleep very well, but where they do have difficulty about sleep it is to be considered from two different standpoints. In a hospital in the acute stage sleep can be induced by a hot pack. In the chronic cases the hyoscin has a tendency to help in the matter of sleep. They are usually constipated, and a diet with bran bread and coarse vegetables is very often helpful.

CLINIC OF DR. ARTHUR F. BEIFELD

COOK COUNTY HOSPITAL

CHLOROSIS

Differential Diagnosis of a Condition (in a Girl of Sixteen) Presenting a Group of Symptoms Frequently Encountered in the Adolescent Female.

Value of the Krönig and Goldscheider Methods of Apical Percussion. Technic of Subcutaneous Tuberculin Test. Accurate Method of Hemoglobin Estimation.

Cardinal Symptoms of Chlorosis. Theories as to its Cause. Atypical Cases. Iron and Arsenic in the Treatment.

THE case I have chosen for our study this morning represents a condition met with far more frequently in the office than in the hospital. The importance of the case is twofold: It varies in certain particulars from the stereotyped picture of the disease of which it is an undoubted example, and is, therefore, frequently unrecognized; and, secondly, it opens a differential diagnosis essential to the recognition of every case, in a girl of this age, exhibiting a similar group of symptoms.

This patient was born in Chicago sixteen years ago. She attended school until she was fifteen, when it was found necessary to keep her at home to assist her mother in the housework. In the past few months, because of an increasing need of sleep, a tendency to tire very easily, dizziness, gastro-intestinal disturbances, shortness of breath and cardiac palpitation, she has been able to work very little.

The patient's mother states that during the last few weeks before the girl was brought to the hospital she has been asleep the greater part of each morning, and this despite the fact that she slept soundly the night through. Toward noon her somno-

lence diminished, and as the afternoon wore on she seemed normal. Another early symptom was a tendency to become fatigued after the slightest exertion, making any but the most trivial tasks impossible for her.

Shortness of breath and palpitation of the heart are additional complaints, being induced especially by running, fast walking, and stair climbing. The mother has noted this paradox, however, that evenings, when the patient is apt to be at her best, she can roller-skate without becoming in the least fatigued and without experiencing shortness of breath or palpitation. Dizziness is most marked when the patient changes her position quickly, though it is present to some extent throughout the day. Associated with this manifestation is that of black spots before the eyes. On three occasions the girl has fainted.

The gastro-intestinal symptoms consist of a bad taste in the mouth; a loss of appetite for the things she formerly enjoyed eating and a desire for unusual articles of food, such as pickles, raw vegetables, and raw meats; heart-burn and sour eructations; occasional periods of vomiting, never, however, of material eaten the day before, and never of blood; a sense of burning in the stomach; and obstinate constipation.

Menstrual anomalies are also present. The flow was established at the age of fourteen, and in six months became regular, being of the twenty-eight-day type and causing little disturbance. In the past six months, however, the girl has menstruated only twice, and on both occasions the flow has been distinctly diminished in amount and associated with considerable pain.

Finally, we note in the history that headache is of frequent occurrence; that the patient occasionally has a stitch in the side; that she is troubled with an almost constant ringing in the ears; that her ankles are swollen; and that she has lost 8 pounds since the beginning of her illness.

The remainder of the history in the case is brief. This is the girl's first sickness aside from measles, whooping-cough, and chicken-pox. Her parents are both alive and well, as are two brothers and two sisters. One sister died at the age of seven of pneumonia. An aunt of the patient died of pulmonary tubercu-

losis, but she was never in close proximity to the girl for any length of time. There is no other similar taint in the family history. The mother has had no miscarriages.

If you will examine the temperature chart you will note that fever of moderate grade is of rather frequent occurrence. At no time has it exceeded 99.2° F. It follows no regular type and is not present every day. The high point is, as a rule, in the late hours of the afternoon. The pulse-rate is almost constantly above the normal, rarely falling below 85 and not infrequently reaching 100 to 110. The respiratory rate is also somewhat accelerated.

The arterial pressure registers 90 systolic and 65 diastolic, figures considerably below the average for a girl of this age. The Wassermann reaction in the blood was negative. (A spinal puncture was not made.)

Physical Examination.—Let us leave the remaining laboratory data for our consideration of the differential diagnosis and turn to the physical examination of the patient. From a group of girls one would scarcely pick her out as ill. She seems well nourished and her cheeks have a pink tinge. Three weeks ago, however, when she entered the hospital her face had little color. Even now her lips, her tongue, the buccal mucous membrane, and the conjunctivæ are pale. At no time was her appearance distinctly anemic.

The conjunctivæ are of a peculiar bluish-white color, with no suggestion of icterus. The pupils are dilated, equal in size, and respond promptly to light and accommodation. Examination of the ocular fundi revealed no abnormalities. A few small lymph-nodes are palpable in the cervical chains on both sides. The tissues about the ankles pit perceptibly upon pressure.

The thyroid gland is moderately and symmetrically enlarged. The struma is soft, but not especially vascular, judging from the absence of thrills and bruits over the gland itself. On both sides of the neck, however, in the region of the large veins, one can see a marked throbbing and can hear a loud, continuous murmur. You will recognize this readily as the humming-top murmur, or the *bruit de diable.*

The lungs have been repeatedly examined for evidence of tuberculosis. The chest is well developed, symmetric, and without suggestion of the phthisical habitus. Both sides expand equally and evenly, and the Litten phenomenon is well marked. Resonance is normal throughout, and the Krönig fields of apical resonance are of normal width and equal on both sides, anteriorly and posteriorly. Percussion of the absolute apical resonance by the Goldscheider method also yields normal results.

It seems advisable to digress for a moment to say a word about the Krönig and Goldscheider methods of apical percussion.[1] They are based on different conceptions and are differently carried out. Krönig's apical fields represent *radiations of resonance* from the apices proper, and the lines which bound these fields mark the limits to which apical resonance carries. An extremely light percussion stroke is employed, the direction of the stroke being perpendicular to the surface of the body. Starting at any point above the clavicle, anteriorly, and over the supraspinous fossa, posteriorly, we percuss mesially and laterally from resonance (if any be present) and join the points thus obtained by lines which extend from front to back. Under normal conditions these fields are not less than 5 cm. in width. Narrowing, generally speaking, means infiltration.

The Goldscheider method, on the contrary, assumes to outline the absolute anatomic apices. In this case we percuss just proximal to the first phalanx bent at right angles, and in the sagittal axis. This is the so-called *orthopercussion*. The stroke is so light as to be just within the threshold of hearing (*threshold percussion*). Anteriorly, for example, the actual apex susceptible of percussion lies just above the clavicle for the most part, and between the bellies of the sternomastoid muscle. The uppermost point, normally, lies between 3 and 5 cm. above the clavicle, corresponding to the level of the neck of the first rib. The high point, behind, is situated at the level of the projection of the spinous process of the first dorsal vertebra.

I shall pass these photographs about, as they illustrate very

[1] For the further details of these methods the reader is referred to the monograph of Bandelier and Roepke (translated by Hunt), p. 49.

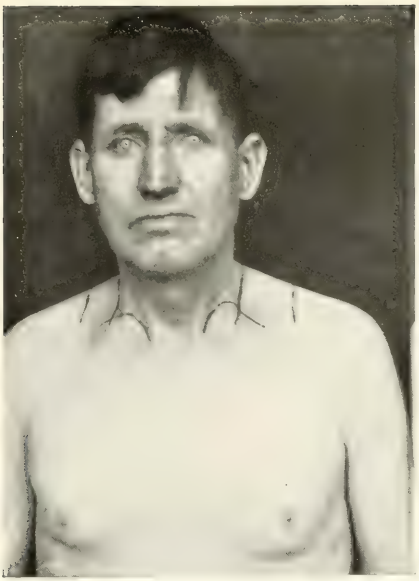

Fig. 153.—Apical percussion in a case of early pulmonary tuberculosis illustrating Krönig and Goldscheider methods.

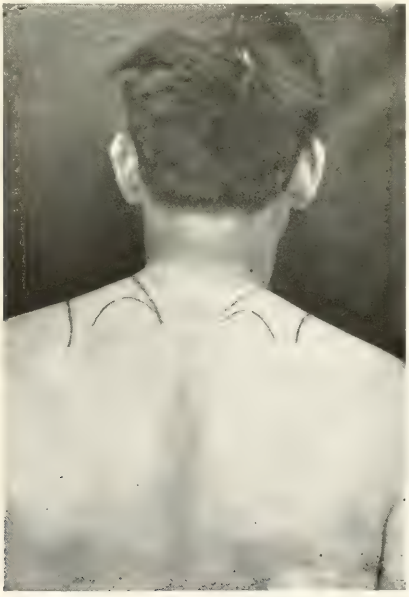

Fig. 154.—Posterior view of Fig. 153.

nicely the two methods. They are taken from a case of early pulmonary tuberculosis, as the narrowed fields on the right side indicate.

Further examination of our patient shows that the lower limits of pulmonary resonance are normally situated, and that the excursion over the bases is excellent. The breath sounds are likewise normal, and there are no adventitious sounds. Nor can râles be elicited over an apex by special methods such as one I have described,[1] in which the patient is instructed to count up to ten in whispers, without breathing, and then to take a long breath. We can say, then, that the ordinary methods of physical examination, reinforced by certain special methods of percussion and auscultation of the apices, reveal no pulmonary pathology.

The apex of the heart is in the fifth interspace, in the mammillary line. It is well circumscribed and easily compressed. No thrills are felt over the precordium. The base of the heart is in the third interspace, the left border corresponds to the outer limits of the apex, and the right border extends 1 cm. to the right of the right sternal edge. *ML*, or the distance from the midsternal line to the left limits of the organ, measures 8.5 cm., and *MR*, the measurement from the midsternum to the right edge of cardiac dulness, 3.5 cm., making *TR*, the transverse diameter, 12.0 cm. The average, according to Dietlen's tables for a girl of this age (height 5 feet 1 inch = 155 cm.) and weight (105 pounds = 48 kg.) is 11.5 cm., indicating that we have to do with a slight enlargement. A loud, blowing systolic murmur is heard over the entire precordium, its point of maximum intensity being in the second intercostal space to the left of the sternum. The murmur is transmitted faintly into the left axilla, fairly well into the vessels of the neck, especially into those of the left side, and can also be indistinctly heard between the scapulæ, to the left of the spine. The second tone over the pulmonary valve is not accentuated, nor is the first sound over the mitral.

The radial artery is straight and soft. The pulse is rapid, regular, full, and very easily obliterated by pressure. There is a suggestion of dicrotism to some of the beats. Also on several

[1] Archives of Diagnosis, October, 1914.

occasions I have noted a capillary pulse in the finger-tips and lips. The niveau of the abdomen is somewhat above that of the chest. Liver and spleen are not palpable. In the region of the sigmoid doughy masses can be felt, composed, evidently, of fecal material.

Both the deep and superficial reflexes, as you see, are very lively. You can observe another phenomenon as I stroke the abdomen with a pin to elicit the abdominal reflexes. This is a very marked vasomotor irritability. The wide zone of hyperemia left by the stroke of the pin will last for several minutes, and even a gentle rubbing of the patient's skin at any point with the finger will leave a splotch of red. Another manifestation of the disturbed vasomotor system is the cold, clammy condition of the girl's hands and feet, contrasting with the dryness of the skin elsewhere. No definite hysteric stigmata have been found, and our own observation and reports from the mother and the nurses indicate no psychic alteration. Finally, you will observe the marked hypotonicity of such muscles as those of the arms and legs.

Dr. Beifeld (addressing Student): With the information I have given you, what suggestions have you to make as to a diagnosis in this case?

Mr. S.: I believe that we must consider in the differential diagnosis incipient pulmonary tuberculosis, gastric or duodenal ulcer, exophthalmic goiter, and, possibly, chronic appendicitis.

Dr. Beifeld: Yes, all of those are possibilities, as are also some latent infection, a mild nephritis, an endocardial process, and a beginning Addison's disease. The things speaking for a diagnosis of early pulmonary tuberculosis are the family history to a slight extent, the loss of weight, the fever, which is usually highest in the evening, the rapid pulse and the weakness. Still, with apparently normal physical findings in the chest, tuberculosis is not a very likely diagnosis in the average case.

We were, however, by no means certain that this was not a case of phthisis, and we did a great deal of work to establish the correctness of our opinion. In the first place, we examined the patient with the fluorescent screen. This showed us that there

were no gross areas of airless lung tissue, that the bases of the lungs moved freely and evenly and that the costophrenic angles were clear, that the apices lighted up well when the patient coughed, and that the mediastinal shadow was normal. No additional information was gained from the stereoscopic plates.

As the patient was producing no sputum, we made the attempt to obtain some by giving her potassium iodid in small doses (5 gr. after each meal for three or four days), and were rewarded by getting several specimens. These were examined in the usual way and were found to contain no tubercle bacilli. They were also subjected to one of the modifications of the antiformin method (see Vol. I, No. 2 of these CLINICS, 1915, page 362), but with negative result. During the time the patient was taking the iodid the lungs were examined at frequent intervals for the appearance of moist râles, which this salt sometimes causes by inducing a catarrh in susceptible tissues, usually the apices. No râles appeared at any time.

The absence of physical signs as militating strongly against the diagnosis of pulmonary tuberculosis has been mentioned. This is, of course, true in the very great majority of cases, but it is just as true that in very early cases, and with such we have to do here if tuberculosis is present at all, there may be no demonstrable changes even by the employment of the refined methods I have called to your attention. These are the so-called pretuberculous cases represented pathologically by a small focus in the mucous membrane of, or in the tissues about, a bronchial twig, and less often in the pulmonary tissue itself. Such a process, though scarcely recognizable by our ordinary methods of physical examination, may produce marked constitutional symptoms.

Tuberculin Tests.—With this possibility in mind, we made use of the most conclusive test for tuberculous infection—the subcutaneous tuberculin test. It is by no means a harmless procedure, and judgment is required both as to when and how to employ it. Even so, an unfortunate outcome is occasionally observed, the tuberculin injected stirring up the original focus, or foci, sufficiently to cause a generalized process. And yet, in carefully selected cases, the subcutaneous method meets best the

requirements in adults. Neusser used to place great faith in the Calmette ophthalmo-reaction as an index of an *active* tuberculosis, but nowadays the test is but little used because of the associated danger to the eye. The von Pirquet method, valuable as it is up to a certain age, tells little in adults unless it is negative, which, as you know, is the case in perhaps 5 per cent. of the cases. In our patient you can still see evidences of a positive von Pirquet reaction, which means only that at one time she was sensitized to tuberculin, not that there is an active tuberculosis present.

The subcutaneous injection of Koch's old tuberculin meets a diagnostic requirement satisfied by no other method. I believe that I may say, without fear of contradiction, that a positive subcutaneous reaction, properly carried out and interpreted, means in a large proportion of the cases that an active tuberculosis is present and responsible for the symptom-picture.

What do I mean by "properly carried out and interpreted"? To answer this question let me tell you what was done in the case before you: For a week before the injections were begun the girl was strictly confined to her bed, her temperature, pulse, and respiratory rates being noted every two hours during the day. It was found that during this period of observation the temperature did not exceed 99.2° F., the pulse-rate did not go above 110, and the respiratory maximum was 24. A slight, subfebrile temperature of this type is not a contraindication to the subcutaneous test. Because of the youth of the patient the initial injection was $\frac{1}{10}$ mgm., which is one-half the dose I employ in the average adult. Koch's O. T., freshly diluted with $\frac{1}{2}$ per cent. phenol solution, was used, and the injection made beneath the skin of the left forearm. The girl, still in bed of course, was watched for three possible reactions—a *local*, about the site of the injection; a *focal*, though in this case there was no suspected location; and a *constitutional*, represented by headache, anorexia, malaise, nausea, and perhaps vomiting, fever above the maximum which she had been showing, and acceleration of the pulse and respiratory rates.

The first injection was followed by none of these. It is important for you to know that a positive response is indicated by a

rise in temperature of a degree or more over the previous standard. If the rise is less than a degree, do not proceed with the next higher dose, but repeat the dose which produced the elevation, as it is a matter of common observation that a second injection of an amount which caused a slight sensitization will often result in a typical reaction. A knowledge of this fact is an additional safeguard against the use of too great doses.

After an interval of forty-eight hours the second injection was made, a dose of $\frac{3}{10}$ mgm. being employed. The results were negative throughout. The highest temperature during this second period of observation was 99.0° F. and the highest pulse-rate 102. After forty-eight hours $\frac{1}{2}$ mgm. was injected. Again there were no reactions. The amount injected was thereupon raised to a full milligram, and finally to 3 mgm., but neither of these two large doses elicited a response. The highest temperature recorded during the entire series of injections was 99.2° F. and the most rapid pulse 106. I will say that in the average adult I ordinarily employ a maximum tuberculin dosage of 5 mgm., and in especially robust males even 10 mgm. In this particular case I considered 3 mgm. a sufficiently high final dose.

This exhausts our diagnostic armamentarium for the recognition of obscure cases of tuberculosis, and I believe we are justified in eliminating this condition from further consideration.

In view of the patient's history of nausea and vomiting, associated with a burning sensation in the stomach and heartburn, the diagnosis of gastric or duodenal ulcer was suggested. I have asked the girl as to the time of appearance of this sensation and its relation to the character of the food taken, but she has been unable to give me any information which would enable me to correlate these facts.

Gastric Analysis.—A Riegel test-dinner, consisting of a dish of meat broth, 250 gm. of lean beef lightly broiled, 50 gm. of mashed potatoes, and a slice or two of white bread, was given late in the afternoon. A dish of prunes was added to the usual formula to serve as an indicator of gastric motility. Under normal conditions this meal has completely left the stomach in seven hours. However, as you know, the fasting stomach is

never quite empty, the work of Carlson having shown that the fasting organ contains on an average 20 c.c. of fluid, the upper and lower limits of the normal being 8 and 50 c.c. respectively.

In our case the stomach was emptied by means of the tube in seven hours and 70 c.c. obtained. The material was an opalescent fluid containing no visible food remnants except prune skins. A few strings of swallowed mucus were present, no blood, free HCl 30, total acidity 45; and microscopically there were found many meat fibers, numerous vegetable cells, a few leukocytes, but no red blood-corpuscles, sarcinæ, or long bacilli.

On another occasion a Riegel meal was allowed to remain in the stomach the night through. In this test the organ was found quite empty, no prune remnants being present. The amount of fluid obtained, however, was greater than on the previous test, 110 c.c. as compared with 70 c.c. The acidity figures were also higher, being 40 for the free and 55 for the total acid. No blood was present.

The Ewald test-breakfast, removed fifty minutes after ingestion, yielded 200 c.c. of well-digested material, with a free acid of 70 and a total acidity of 90. Blood was likewise absent here.

The fractional method of estimating the acidity of the stomach contents, removing material every fifteen minutes for examination, was also employed in this case after an Ewald meal. I am using the Kanavel modification of the Rehfuss tube which differs from the original chiefly in having a steel stylet to facilitate introduction. By this method the high point both of free and of total acid was found to be seventy-five minutes after the meal was eaten.

As you have noted, there are several variations from the normal, as shown by the gastric analyses. In the first place, there is a slight disturbance of gastric motility. This conclusion is justified when the stomach is not completely empty seven hours after the eating of the Riegel meal, but is empty the following morning. In the second place, the amount of fluid remaining in the stomach after these meals is greater than what is generally called normal. In view of the fact that this fluid is practically

clear, and that there is no evidence of gastric stagnation, such as is indicated by the presence of sarcinæ, for example, we are justified in assuming that this fluid accumulation is not due to a pyloric stenosis. The Röntgen-ray examination will also, as we shall see, show that food passes readily through the pylorus. We must conclude, therefore, that although there is present a slight degree of motor delay, the chief cause of this accumulation of fluid is a hypersecretion of gastric juice.

This assumption fits in well with another abnormality found, namely, the hyperacidity as shown both by the material obtained from the fasting stomach and in that from the Ewald meal. Hypersecretion and hyperacidity go hand in hand, and many so-called cases of the latter are in all probability conditions of excessive secretion, the high acidity of which is the result merely of the *large amount* of acid juice poured out.

The **Röntgen examination** of the gastro-intestinal tract gave the following information: The stomach contained a very small rest six hours after the barium meal, confirming the mild degree of motor insufficiency shown by the Riegel meal. The stomach lies almost vertically and there is a slight ptosis. There is no evidence of ulceration. The barium bolus passes readily into the duodenum, especially when the patient is placed upon her right side, and the outlines of the first part of the duodenum are of normal configuration, speaking against ulceration at this point. So far as one can determine by means of the *x*-ray there is no pathology in the appendix region, and the remainder of this examination shows no abnormalities in the gastro-intestinal tract.

The stool, finally, on a meat-free diet has repeatedly contained no blood.

In the face of these findings, especially the complete absence of pain, the absence of blood in the stomach contents and stool, and the negative Röntgen-ray data, I think you will agree with me that the assumption of a gastric or duodenal ulcer has little basis in fact. The hypersecretion and hyperchlorhydria can be otherwise explained, and the slight motor delay, as shown by the presence of prune skins seven hours after the Riegel meal, is due

not to spasm or stricture about the pylorus, but to a lack of tone of the gastric musculature analogous to what we have observed in the skeletal muscles.

As to chronic appendicitis there is little to be said. The absence of spontaneous pain in the history, and of tenderness over the appendix region, as can be seen now, and as we observed when the organ could be exactly localized by means of the fluoroscope; the absence of peri-appendiceal adhesions as judged from the free mobility of the cecum; the lack of periodicity in the illness, and the character of the temperature—all of these render highly improbable the diagnosis of chronic appendicitis.

Exophthalmic goiter or, as we had better call it, hyperthyroidism, has also been suggested to explain the symptoms in this case. It certainly must be considered among the possibilities. A persistent tachycardia, such as we have here, unless otherwise explained, should always make us think of one of two conditions —tuberculosis, which we have ruled out, and hyperthyroidism. As you know, we meet with fully developed forms of this disease in which all of the classical symptoms are present, and also undeveloped types, or *formes frustes*, in which these classical symptoms are in the background or absent. Among the more important of the symptoms of these undeveloped cases are a more or less constant tachycardia, loss in weight, palpitation of the heart, pain about the heart, and evidence of beginning myocardial degeneration, nervous irritability and psychic alterations, menstrual disorders, slight tremor, gastric disturbances, diarrhea, and a tendency to profuse perspiration. In a given case one or more of these manifestations may be present and in variable degree.

In our patient the rapid pulse, the shortness of breath, the palpitation, the loss in weight, the gastric disturbances, the dysmenorrhea, and the enlargement of the thyroid are suggestive. In my opinion, however, the weight of the evidence is against this diagnosis. First of all, I should emphasize the placid disposition of the girl as being utterly inconsistent with the hyperthyroid state. Also not in keeping with the latter are the somnolence, the constipation, the dry skin, and the absence of any suggestion of a tremor. The slight goiter is better explained as one of ado-

lescence. It is perhaps also of some significance that the administration of potassium iodid, which may of itself stir up a latent hyperthyroidism, had no effect upon our patient.

I have mentioned four other possible diagnoses in this case—a latent infection, chronic endocardial disease, which is more or less allied to the first, nephritis, and Addison's disease. A careful examination has shown nothing abnormal in the usual sites of a focal infection. The tonsils, the teeth, the accessory sinuses, the ears, the gall-bladder, and appendix regions seem entirely normal. Repeatedly negative blood-cultures make both this diagnosis and that of a subacute process on the endocardium unlikely.

Urinalysis.—The results of the urinalyses have been normal with the exception of a trace of albumin in every specimen. No casts were found. Nephritis is suggested, however, by the albuminuria, the headaches, the somnolence, the vomiting, and the cardiac enlargement. With a duration of three months or more, we should perhaps expect some elevation of the arterial pressure and harder vessel walls, while the constant absence of casts is unusual.

The last of the possibilities mentioned is Addison's disease. The symptoms suggesting this are the low arterial tension, the weakness, the diminution of muscular tone, the weak, rapid pulse, and the gastro-intestinal disturbances. The absence of pigmentation in the oral mucous membrane and the skin, the negative tuberculin reaction, and the improvement under treatment—all these factors make it unlikely that we have to do with Addison's syndrome.

This exhausts the list of probable diagnoses suggested for this case, except that of an early pregnancy, which we have excluded. We have weighed the evidence for and against each, and have found none of them satisfactory.

Blood Examination.—As a final step in establishing the diagnosis I shall read you the results of the blood examinations, which are substantially alike. The figures given below were obtained three days ago:

Hemoglobin (Sahli corrected)	90 per cent.
Erythrocytes	4,600,000
The red blood-cells are normal except for a very slight poikilocytosis and anisocytosis, the variants from the normal in size all being small cells.	
Color-index	1 (minus)
Leukocytes	7200
Distribution:	
Polynuclear neutrophils	68.5 per cent.
Lymphocytes	24.0 "
Large mononuclear and transitional cells	4.0 "
Eosinophils	2.5 "
Basophils	1.0 "
Blood-platelets	Considerably increased.

I think that I have already explained to you the use of the newest Sahli hemoglobinometer. The figures in the scale do not represent hemoglobin in percentage, as do most instruments, but certain arbitrary standards. In the first place, the hemoglobin *normal* varies not inconsiderably with differences in the sea level. The figures for the normal of this instrument apply to Berne, in Switzerland. Secondly, the sexes show differences in the average normal readings, that for women being about 10 points lower than that for men. Sahli insists also that there is no fixed normal reading, such as 100 for men and 90 for women, but that the range of normal is roughly from 80 to 100 for males and from 70 to 90 for females.

The 100 mark in this new instrument represents the average color of the hemoglobin (diluted, of course, with $\frac{N}{10}$ HCl) of the most robust of Sahli's male students. It is not 100 per cent., but an absolute 100. Eighty in the scale represents the average minimum normal for men. Similarly, 90 to 70 are the average normal limits in women.

In view of the variations due to differences in the sea level, Sahli suggests that each man using the instrument find the normal average for his particular elevation above the sea. In order to reduce the absolute figures which we read off the scale to percentages, which is necessary, for example, to compute the color-index, you must do the following:

1. Determine the *average normal* reading for men and for

women in the locality in which you work. My standards are 90 for males and 85 for females. I have found, as you note, a difference of only 5 points between the sexes.

2. Estimate the hemoglobin for the particular patient.

3. Use the following formula to reduce the absolute figure obtained in 2 to a percentage basis:

$$\frac{x \text{ (patient's reading)}}{90 \text{ (local normal for males)}} \times 100 = \text{percentage hemoglobin.}$$

In order to make one's results intelligible to others Sahli suggests further that readings thus reduced to a percentage basis be marked "corrected per cent."

The uncorrected Sahli reading in our patient was 76. Using the formula I have given you, we have—

$$\frac{76}{85} \times 100 = 90 \text{ (minus) corrected per cent. (Sahli).}^{1}$$

This is practically normal blood. Yet, the poikilocytosis and the anisocytosis—even though they are not marked—and the increase in the blood-platelets indicate that there is something amiss here. The increase in the platelets is common in many of the anemias, particularly in chlorosis and in certain of the secondary types, such as that associated with myeloid leukemia, while differences in size and in shape may be found in any anemia. I have used the term "anemia," but have we to do with an anemia as the term is generally understood? A hemoglobin of 90 per cent. is scarcely outside of the limits of the normal, and a red cell count of 4,600,000 is quite normal for an adult female. The color-index is only slightly less than 1, the number of white cells per cubic millimeter is perfectly normal, and the differential count of the leukocytes shows no abnormalities.

Despite the fact that the blood in this case approaches the normal so closely, I will say that we are dealing with a typical primary anemia. What is this type of primary anemia, Mr. S.?

MR. S.: It can only be a chlorosis.

DR. BEIFELD: Yes; in view of the train of symptoms I have

[1] See Sahli, "Diagnostic Methods (Potter)," 2d ed. (revised), 1911, p. 75.

given you, in view of the possibility of ruling out those other conditions which may produce a somewhat similar clinical picture, and, finally, in view of the therapeutic response obtained in this case—which I have not as yet told you about—I have no hesitation in diagnosing this case as one of chlorosis.

You will at once object to this diagnosis because of the absence of those blood findings which we have been taught to believe were characterized, above all, by a sharp reduction of the hemoglobin out of proportion to the diminution in the number of red blood-corpuscles. This would mean, in other words, a very low color-index.

This teaching, however, can no longer be accepted in its entirety. There are two co-ordinate parts to the picture of chlorosis, the clinical and the hematologic. But you must not go away with a misconception of my meaning in this matter. The great majority of cases of chlorosis present both a characteristic group of symptoms and an unmistakable blood-picture. Nevertheless, you must become familiar with the minority of cases to which this patient belongs, and which, with few or no blood alterations, are, clinically, typical. Well-authenticated cases of this kind are described in the literature,[1] and this is the second case that has come to my personal attention.

Types of Chlorosis.—While we are discussing this point let me give you for future reference a table of the types of chlorosis based on changes in the hemoglobin, red cell count, and color-index. This outline is taken from Naegeli's Hematology:

Group I.—Cases of clinically typical chlorosis in which the hemoglobin and erythrocytes are quite normal or vary from the normal only within physiologic limits. The red cells run between 4,500,000 and 5,000,000, and the hemoglobin between 90 and 100 per cent. (Sahli corrected). These are sometimes termed *larval* cases.

Group II.—Cases of moderate severity, with a hemoglobin of 60 to 50 per cent., in which the red blood-cells remain approximately normal or are only slightly reduced (4,000,000). The color-index in these cases is obviously low.

[1] For example, those of Morawitz, in the Münch. med. Woch., 1910, 1425.

Group III.—Severe cases with very much reduced hemoglobin (20 to 30 per cent.) and red cell-count (1,500,000 to 2,000,000). The index remains low.

Group IV.—Severest cases (rare). Arneth has reported 10 per cent. hemoglobin and 1,400,000 red cells; Weinberger, 12 per cent. hemoglobin and 1,600,000 red cells; Hayem, 1,606,000 erythrocytes and a color-index of 0.36, and also 937,000 red cells and 0.85 color-index.

The diagnosis of our case rests, as we have indicated, upon two factors: a characteristic clinical picture and a response to specific treatment. First of all, it is important to know that certain etiologic factors are present, in the absence of which chlorosis cannot be diagnosticated. The disease occurs exclusively in the female sex; it appears usually at puberty, cases beyond the twentieth year generally being recurrences, which are common; and it arises without apparent cause, toxic or otherwise. Unsanitary surroundings, poor light and air, insufficient food, etc., can hardly be the underlying causes, as the disease is observed in all stations of life.

Symptomatology.—Among the more characteristic symptoms are the *sleepiness* shown by our patient, and which in doubtful cases speaks against tuberculosis and hyperthyroidism; the great *asthenia*, associated with a *hypotonicity of the muscles* and a *low blood-pressure; the cardiac manifestations*—rapid, often dicrotic pulse, dilatation, hemic murmurs, dyspnea, palpitation and ankle edema, though the latter is to a great extent due to the hydremic condition of the blood; the *menstrual disorders*, practically always present in some degree, with a tendency toward a diminished flow rather than toward an increased; the *vasomotor disturbances*, evidenced by the cold hands and feet; and the influence of *psychic factors*, as is shown by the ability of the girl to skate for extended periods, though light household tasks completely exhaust her. The cardiac murmur which I have described to you has a soft non-valvular character not found in those due to changes on the valve leaflets, while its point of maximum intensity over the pulmonary valve and the rest of the clinical picture stamp it as a hemic blow. The *enlargement of the heart* is the result in a great

part of myocardial flabbiness, though the so-called hypertrophy of adolescence may be a factor. The slight *albuminuria* is readily explained on the basis of the anemia. The edema is generally attributed to the hydremic character of the blood in chlorosis and to the associated anemic injury of the capillary walls. Possibly, in some cases, a weakened myocardium plays a part. Hypersecretion and hyperchlorhydria are of common occurrence in chlorosis, though it is interesting to note that at one time an HCl deficiency was considered the cause of the disease. Finally, regarding the slight delay in the emptying of the stomach, it may be said that well-marked atony is very rare in chlorosis. The frequent association of the two conditions formerly noted was surely based on false premises.

Theories as to the Cause of Chlorosis.—Various theories have been held from time to time as to the cause of chlorosis. I have already said that certain influences, such as living in surroundings where the light, air, and sanitary conditions are deficient, improperly chosen and insufficient food, and hard work and long working hours play only accessory rôles. These were formerly emphasized as basic causes because of the predominating occurrence of the disease in girls of the working classes. However, that these are not the immediate causes is shown by the fact that chlorosis is seen by no means infrequently in girls of the better situated strata of society. No more satisfactory are certain other explanations, such as the effect of tight lacing (emphasized because of the frequency of gastric ptosis), constipation and intestinal auto-intoxication, an infection or oral sepsis.

French observers have attributed the condition to a tuberculous infection. It was for this reason, in addition to the fact that our patient presented a number of symptoms suggestive of tuberculosis, that we went at length into the differential diagnosis of phthisis. While it is true that chlorosis and tuberculosis are not infrequently found in the same individual, there is no evidence to show that the association is any but an accidental one.

For a considerable time the theory of Virchow was widely accepted, which held that the condition was a congenital anomaly characterized by a small heart and blood-vessels, a narrow aorta,

and hypoplastic genitalia. Though the influence of the secretion of the ovaries is probably of great significance in the etiology of the disease, and though ear-marks of the *status hypoplasticus* are frequently found in association with cases of chlorosis, the theory of Virchow has little in its favor: first, because the symptoms of an aortic stenosis are quite different from those of chlorosis; further, because in well-marked cases of genital hypoplasia and amenorrhea the patient may show no signs of an anemia; and, finally, because it would be difficult to explain the almost invariable tendency to recovery in chlorosis were the disease due to congenital anomalies.

There are some who maintain that the anemia is not the cardinal feature of the disease. Grawitz, for example, believes the condition to be a neurosis, on the ground that the subjective symptoms are often out of proportion to the blood changes—as in our case—and that a large proportion of the symptoms are nervous, vasomotor, or psychic. This theory has few adherents. Morawitz, though conceding the vital importance of the anemia as a symptom *among others*, does not believe that it is the essential feature of the disease. Among his reasons for this view are the following: (1) The not infrequent occurrence of cases such as ours (larval cases) in which, though the subjective symptoms are distinctive, the blood changes are extremely slight: (2) The fact that such manifestations of chlorosis as the menstrual disturbances, the venous hum and the hydremia, as well as the majority of the subjective disturbances, may be due to causes other than an anemia. (3) The lack of proof that iron exerts its beneficial action in the disease by stimulating the blood-forming organs, much less the hemoglobin-forming organs. The inefficacy of iron in almost all other anemias (in contrast to the stimulating action of arsenic) speaks against the value of iron as a stimulant to the bone-marrow.

Morawitz concludes that the essential feature of chlorosis is still unknown, and that iron exerts its beneficial effect by acting upon the still undiscovered primary disturbance in the disease.

Friedrich Müller has called attention to the frequent association of symptoms of hyperthyroidism with those of chlorosis, and

he has applied the term "pseudochlorosis" to cases of early hyperthyroidism with features simulating chlorosis. For this reason we have laid considerable stress upon hyperthyroidism in the differential diagnosis of the case before us.

One of the most acceptable theories as to the cause of chlorosis is that of von Noorden, who, taking into consideration the constant etiologic factors of age and sex, attributes the disease to anomalies in the secretion of the ovaries in predisposed individuals. Further, according to his conception, the ovaries exert under normal conditions a stimulating effect upon the blood-building organs. This stimulus is decreased in variable degree in chlorosis and can be supplied by the administration of iron.

I have already called your attention to objections to this reputed action of iron. In view of this fact and others previously noted, Morawitz believes that a theory best suited to explain chlorosis would be one based upon the assumption of a disturbance of several or all of the glands of internal secretion. You will recognize the strength of this theory in the points of contact of the symptom-picture of chlorosis with those of hyperthyroidism, Addison's disease, and ovarian disturbance.

There is practically no postmortem evidence on this point, as the great majority of cases terminate in recovery. In the few patients (death being due to other causes) upon whom autopsies have been held no degenerative changes were found in the parenchymatous organs and no changes in the bone-marrow of the tibiæ.

We are somewhat better acquainted with the essential nature of the blood changes in chlorosis. It is more or less generally accepted that there is an insufficient formation of red blood-cells. This view is based upon two grounds: first, the response of these patients to the administration of iron; second, the absence of evidence to show that the opposite condition is present, namely, that there is an increased destruction of erythrocytes. Were the latter true we should expect to meet with jaundice and an increase in the quantity of pigments in the urine and feces. This, however, is not the case. The final proof of an augmented destruction of the red blood-corpuscles—namely, an increase in the amount of

iron pigment in the liver—cannot be adduced because of the lack of postmortem material.

Treatment.—I wish at this time to consider only the significance of iron and, to a lesser extent, of arsenic in the treatment of chlorosis. **Iron** is practically a specific in this disease; so much so, in fact, that a favorable response on the part of the patient to its administration is of enormous diagnostic value. I may add that the metal is of considerable value also in those anemias following an acute hemorrhage, while in the secondary anemias of the more chronic types and in pernicious anemia it is of extremely limited service.

Our patient has responded very promptly and decisively to the administration of the remedy, which has been given in association with arsenic. The improvement in her condition, which manifested itself in about two weeks after the treatment was begun, has been evidenced not by any appreciable change in the amount of hemoglobin or in the number of the red blood-corpuscles, but by a gradual subsidence of the subjective disturbances. Her need of sleep has been materially decreased; the lassitude and asthenia are less marked; the appetite for substantial food has returned, and there is now little complaint with reference to the stomach; the pulse has remained below 100; the temperature has been normal for an entire week; and the subjective cardiac symptoms have been little in evidence, although the patient has been on her feet a part of each day during the past week. In addition, as I have already said, her cheeks have a little color. All in all, the change in the patient's condition is so obvious as to leave no room for doubt as to the correctness of the diagnosis.

How is this brilliant action of iron in chlorosis exerted? In all probability in two ways: by supplying a material essential to the building of the hemoglobin molecule and, as von Noorden has urged, by acting as a direct stimulus to the bone-marrow. I have already called your attention to the opposing view of Morawitz, who says that if such a stimulation actually occurred we should have a right to expect a similar action in the other anemias. But, as has already been stated, iron has a very limited value in anemias other than chlorosis, contrasting in this particular with

arsenic, which is definitely a bone-marrow stimulant. Morawitz then goes on to say that iron acts not upon the bone-marrow, but upon the still unknown basic cause of chlorosis, which is possibly a disturbance of the correlated secretions of the ductless glands.

Some such hypothesis seems necessary to explain one problem which has always proved a stumbling-block to physiologists and clinicians. This is the fact, which any one of you may observe in chlorosis and which has been verified by animal experiment (acute anemias), that food containing more than the amount of iron necessary to maintain health has generally no influence upon the course of the disease, while preparations of iron administered as such are curative. A few figures relative to this question may be instructive. Thus, it has been estimated that the amount of iron in the tissues of the healthy adult, chiefly in the form of hemoglobin, is only about 2.5 to 3.5 grams, while an average dietary sufficient to maintain the iron equilibrium need not provide more than 5 to 10 mgm. ($\frac{1}{12}$ to $\frac{1}{6}$ grain) per day. It is obvious from these figures that there exists no great difficulty in furnishing sufficient food-iron to maintain an equilibrium of the metal in health.

In health, furthermore, about the same amount of iron is excreted—chiefly in the feces—as is ingested in the food. When the iron intake is increased, elimination by the stools is greatly augmented. The urine, however, is found to contain but little more than under ordinary conditions, from which it was concluded that no iron was absorbed. But this view was based on the false conception that the chief mode of elimination of the metal was via the kidneys.

A portion of the iron taken by mouth passes through the intestinal tract directly into the feces. The remainder, as shown by histologic methods, is absorbed chiefly from the duodenum, probably through the agency of the blood-vessels, and is stored eventually in the liver and perhaps in the bone-marrow. A portion of this stored iron, in turn, is utilized in the formation of hemoglobin as the needs of the body dictate, while the remainder is returned to the intestines and enters the stool. The evidence at hand goes to show that only a very small proportion of the iron

taken by mouth is destined to be employed in the formation of hemoglobin, the great bulk of the ingested metal passing directly through the bowel into the feces.

This is unquestionably one mode of action, whether taken in the food or as inorganic iron. But there still remains the problem of the failure of food-iron to cure chlorosis in the majority of cases, although the amount ingested is far in excess of what even a hemoglobin-poor individual is in need of. Indeed, chlorosis not infrequently appears in girls who have never suffered from a deficiency of iron in the food. Von Noorden, as I have already told you, assumes that inorganic iron acts as a specific stimulant upon the bone-marrow. But Morawitz, as you will recall, disputes this reputed action of the metal, and says that we can conclude only that iron acts specifically upon the still undiscovered cause of chlorosis, this cause possibly being a disturbance of the correlated hormones.

It is possible that the difference in the action of food-iron and inorganic iron is not so deep-seated a one as is generally supposed. Perhaps it is only a matter of the rapidity of absorption of the two, food-iron being absorbed much more slowly than the other. Again, there may enter into the question the matter of mass action; that is, if it were possible to ingest at one time enough food to introduce into the body the amount of iron ordinarily given as a remedial dose, then the food-iron might be as beneficial as an equal amount of inorganic iron.

I have already indicated to you that it is in chlorosis particularly that the brilliant action of iron is exhibited. Nor does it matter greatly in the average case in what form the metal is given. It is perhaps for this reason that we do not see more cases of the disease than we do, for it is common among the poorer classes to buy, without a prescription, one of the many advertised remedies for "anemia," when it is apparent from the pallor that such is the diagnosis, and, as most of such preparations contain a certain amount of iron, a recovery is usually effected.

I do not wish to enter in detail into the question of the comparative value of inorganic and organic preparations of iron. The latter, as you know, are combinations of the metal with

various protein bodies. Without discriminating among these proprietary organic combinations, I may say that they are valuable in the treatment of chlorosis in proportion to the amount of iron—in terms of metallic iron—which they contain. They are advocated chiefly for cases with intolerant stomachs, and there is no doubt that in such cases they may occasionally meet an indication. Just as with certain widely advertised organic combinations of iodin and bromin, designed to sit lightly upon the uneasy stomach, they lose in efficiency what they gain in elegance and palatibility. And as with most proprietary remedies it is generally difficult to control the dosage, a matter of prime importance, especially in chlorosis.

The same arguments apply in great part to preparations of iron given subcutaneously. The combination particularly used in this way is the citrate, alone or associated with arsenic or other drugs. Possibly in a few cases the stomach is so irritable as to demand this method of administration. On the other hand, there are certain strong objections to the subcutaneous treatment. In the first place, in order to introduce the amount of iron generally deemed sufficient as the per diem dose (0.1 to 0.15 gram of metallic iron), it is necessary either to inject a large bulk at one time, which is by no means a painless procedure, or to make frequent injections, which is scarcely more desirable. The treatment by injection is especially unsatisfactory when the combined iron-arsenic method is employed, as it is difficult to control the dosage of the arsenic.

In the very great majority of cases of chlorosis one can obtain an eminently satisfactory result by the use either of reduced iron or of the freshly prepared Blaud's pill. But no matter what preparation of iron one prescribes, complete success will not follow unless the dosage be great enough and the duration of the cure be prolonged enough. As recommended by von Noorden, and agreed to by most observers, an adequate daily dose in terms of metallic iron is 0.1 gram (1½ gr.). We may say that the average case requires a six weeks' course of treatment. During the first week the dosage should be somewhat below 0.1 gram; during the next three weeks the full daily amount (0.1 to 0.15 gram)

should be exhibited; and during the last two weeks the dosage should gradually be reduced. Just as with the employment of quinin in malaria, the salicylates in rheumatism, mercury in syphilis, and digitalis in decompensated hearts, enough must be given to produce results and especially to prevent recurrences. Up to a certain age recurrences are very common in chlorosis, and to obviate these as much as possible it is advisable not only to treat the original attack thoroughly, but to keep the patient under observation and to institute courses of iron treatment three or four times a year, even though she is in apparent good health.

If one makes use of the reduced iron, and I feel safe in recommending it to you most highly, there is no difficulty in prescribing the exact amount of iron desired. As we first increase the dose and later reduce it, it is best to combine nothing in the capsule with the iron. It is convenient to prescribe 0.05-gram capsules, coated with keratin, if the patient's stomach tends to be intolerant. At first one of these capsules is given each day. At the end of the week two are prescribed, and later three or even four, and this maximum dosage continued for three weeks. In the last two weeks of the course, as already indicated, the number of capsules is gradually reduced.

If you prefer the official Blaud's pill, which you had best prescribe in capsule and also keratin coated, you may begin the treatment with one capsule three times a day, increase the dose to two, three, and even four capsules three times a day, and in the last period again gradually reduce the number.

It will serve no useful purpose to discuss any of the other numerous pharmacopeial preparations of the metal. There is none without some value, and they are all curative if given in sufficiently large dosage and over a long enough period. My advice to you is to become thoroughly familiar with a few—and no two are superior to those I have mentioned—and to employ those intelligently.

Iron is a specific in the treatment of chlorosis, though its exact mode of action is not known. Some of it is undoubtedly absorbed and helps to build the hemoglobin molecule, and a larger part of it, as von Noorden believes, acts perhaps as a stimulant

to the blood-forming organisms. Though observers are not unanimous as to this latter function, they are agreed that there is a drug which does stimulate the bone-marrow. This drug is **arsenic,** and arsenic has proved of great value in the treatment of chlorosis, especially, it would seem, when combined with iron.

As with the iron, I always prescribe the arsenic alone in order more easily to control the increasing dosage. Fowler's solution answers every requirement. I begin with 3 to 5 minims three times a day, and increase the total daily dosage by 1 minim until the patient is taking 15 minims at a time. In case symptoms of arsenic intoxication appear, the increase is not pushed, of course, the amount being diminished to a safe point. When, as is generally the case, the arsenic is well tolerated, the dosage is reduced a drop per day after the upper limit has been reached. This alternating increase and decrease is then continued during the course of the treatment.

In place of Fowler's solution you may use the arsenic trioxid, which is best prescribed in capsules each containing $\frac{1}{60}$ grain. Beginning with one such capsule three times a day, one capsule is added each day to the total dosage and continued until two or even three capsules are given three times a day, when the dosage is gradually reduced, as with Fowler's solution.

The only other drug generally found necessary is a laxative to offset the constipation usually present either as a symptom or created by the iron. I employ for this purpose the aromatic fluidextract of cascara, which may be given in the amount found necessary at bedtime.

I have reserved for another time the discussion of the remaining features of the treatment of chlorosis. As you know, rest in bed, a properly selected diet, hydrotherapy, chalybeate waters, etc., all have an important place in the therapeutic régime. These I shall take up in a later clinic along with measures of a similar nature found serviceable in the management of the other anemias, particularly the pernicious type.

CONTRIBUTION BY H. H. SCHUHMANN, M.D., D.D.S.

CHICAGO

THE RELATIONSHIP OF ORAL FOCI OF INFECTION TO SYSTEMIC DISEASES

Direct Interrelationship of Systemic Disease to Oral Foci of Infection not Conclusively Proved. Alveolitis and Blind Abscess as Foci of Infection. Beneficial Results of Proper Treatment.

IT is not possible in the short space allowed for a paper of this sort to go into the scientific details of a subject of this nature such as the title surely well deserves. I must ask my readers to forbear with me if I am not quite as explicit with reference to certain phases of the subject as I might be if time and space were of no consideration.

The conclusion that the human mouth is an excellent incubator for pathologic germs and at times performs a significant part in the production of various bodily disorders has in the last few years become stronger in the minds of physicians and dentists as well. That the constant presence of deleterious microbes, particularly those of the pus-producing varieties, in the oral cavity must of necessity have detrimental effects not only on the eliminative organs, such as the kidneys, liver, intestinal tract, and skin, but on other organs as well which are reached by these toxins and germs carried there by the circulatory apparatus, is a well-established fact, and no one, I think, at this time will dispute this assumption. Drs. Rosenow and Billings claim to have conclusively demonstrated the serious results of mouth infection on the valves of the heart, and other earnest workers, such as Medalia (Professor of Bacteriology at Tuft's Medical

College) and many others, claim to have demonstrated concomitant diseases frequently found closely linked to oral infections. Professor Medalia, in particular, has shown the tremendous improvement in conditions such as rheumatism, boils, furuncles, interstitial nephritis, and acne by the use of autogenous vaccines for the treatment of alveolitis in conjunction with these diseases. Personally, I have had quite a number of most interesting experiences along these lines which bear out the theories and results Medalia mentions; that is, the autogenous vaccines made from the mouth in these cases of alveolitis have shown marked beneficial results not only in regard to the oral condition, but on the various constitutional disturbances as well. Such results may be interpreted, at least clinically, as fairly efficient proof of an interrelationship of these conditions. Of course, such proof hardly justifies us at this time to accept *prima facie* the positive statement which is so frequently made, namely, that *direct* interrelationship of systemic diseases to oral foci of infection has been conclusively and scientifically proved, but it does seem that we may accept this theory, at least to the extent that oral foci of infection have a decided influence on general health and diseased conditions. Many physicians besides Hunter, Goadby, Rosenow, and Billings have proclaimed this *direct* interrelationship and etiology more or less definitely. That the absorption of pus germs or their toxins through the lymphatic system from the mouth and throat is of a nature to favor the production of adenitis and lymphatic tumors is a well-established fact. Acute and chronic polyarthritis are affections well within the possibilities of being considerably influenced by oral infections, and in many cases this is definitely claimed to be the *actual* and *sole productive* cause by Judson, Donald, and Medalia. Alveolitis, pyemia, and septicemia is another combination which has been dwelt upon in our literature to a considerable extent, and the *primary* producing cause of these systemic disturbances laid to these oral infections.

To grasp the situation a little more clearly it might be well to divide the question of oral foci of infection into two different categories, namely, such arising from alveolitis (osteomyelitis,

pyorrhea, Rigg's disease) and those finding their cause in such foci of infection as can be included under the heading "blind abscesses." As to alveolitis and its infectious possibilities a word regarding the anatomic relationship of the area involved may be of interest. This is a disease which in its inception, in the majority of cases, is started by traumatism. There may possibly be other causes which as yet have not been conclusively demonstrated. At any rate, the usual first manifestations are mild inflammatory conditions possibly reaching the pus stage, and which are later perpetuated by the deleterious influence of the pus-producing micro-organisms. More recently it has been learned that it is the presence of the foreign (or heterologous) protein in the protoplasm contained in the bacteria that causes the injury to the body cells. Miller, Galippe, Hunter, and others have shown pyogenic germs to be constantly present in these cases of alveolitis. The pneumococcus (also in chain form), the Staphylococcus aureus and albus are practically always present, and very frequently the Micrococcus catarrhalis and various forms of other pyogenic bacteria. The proportion in which these different organisms occur is very uncertain. Naturally, the question of immunity plays a big rôle in the development of these chronic infectious conditions. In our circulatory fluids immunity is represented by the presence of various antibodies, and of these the ones interesting us most in this connection are such antibodies which when present will hinder the growth of pus-producing organisms. These antibody forces may at times develop strongly against a certain group or variety of bacteria, and at other times against an entirely different type. In other words, it is selective. If at the time of primary infection of the gingiva the degree of immunity or opsonic index should be low against pneumococcus or streptococcus, a full-fledged case of alveolitis might be expected to follow. The battlefield for these germs is the medullary space in the maxillary bones holding the teeth, commonly known as tooth-sockets, and also in the ligamentous attachment of the teeth. I can merely mention another phase of immunity or susceptibility to disease, namely, that due to altered reaction of the oral fluids and of the blood—to cover such

ground would cause me to go into extensive research, into the study of the effect of this reactional phase, which requires a minute understanding of the enzymotic action of the phagocytes relative to leukoprotease versus lymphoprotease. In fact, in studying the etiology of alveolitis so many matters enter into the field that if we care to take up the study of these conditions in a really scientific manner it becomes almost bewildering. That these open pockets around the necks of teeth harboring in great quantities freshly created virulent organisms may readily cause other infections by virtue of the products being constantly swallowed and being swept across the tonsils and other lymph-nodes, and are likely to be absorbed by the small capillaries and lymph-vessels about the necks of the teeth, seems rational. While such direct secondary infection has not in a scientific manner been definitely proved, the avenues of access, together with the fact that autogenous vaccines from the primary seat of infection seem to attack both primary and secondary infection, permit us at the present time to accept this much of these theories—that some oral foci of infection have a decided influence on general bodily health.

As to blind abscess, considered from an anatomic standpoint, it is a small sac, ranging from the size of a pin head to that of a coffee bean. The walls of this sac are made up of fibro-elastic tissue. They are quite thick and are filled with a purulent exudate containing a suspension of bacteria. According to the views of Thomas Gilmer the prevalent organism is the Streptococcus viridans. The space for this sac at the root end of the tooth is, of course, in health not present, but is produced by absorption of bone-cells, thus forming a bone cavity for the seat of the abscess. The causes of these blind abscesses are usually poorly filled roots of teeth, or roots of teeth in which the canals have become infected. The strange feature and great differential point about such abscesses, compared to the ordinary alveolar abscess, is that they are both caused by similar infectious procedures, the one developing into a large abscess filled with virulent pus which usually finds its way through the bony wall of the tooth socket into the soft tissues, emptying itself either through the mucous membrane

of the oral cavity or finding an exit at some other point, and associated with it there is severe pain, local swelling, and general fever, chill, and malaise, while with the blind abscess the conditions are vastly different. This is a chronic affair, and notwithstanding its presence for years and years it creates little or no local symptoms, and is only found to be in existence when the *x*-ray is used for the purpose of determining in pictures the conditions present about doubtful root ends.

Unfortunately, it has become among physicians quite a prevalent idea that the diagnosis of blind abscess from *x*-ray films is a very simple matter, and a great many erroneous diagnoses have thereby been made. The differentiation of the meaning of darkened areas found in *x*-ray photographs of root ends may mean a variety of things, and must not empirically be decided upon as abscess; the very fact that drugs and chemicals used in the process of devitalization and in the treatment of root canals by dentists are frequently strong escharotics and coagulants render it quite impossible to suspect, as a consequence, that a great many of those dark shadows are nothing more than coagulated lymph in the lymph-spaces and in the periapical space about the root end, and frequently, therefore, are not at all expressions of pathologic conditions or blind abscess. There are many other conditions that on *x*-ray pictures very closely simulate blind abscesses; I would, therefore, caution my medical confrères to leave the diagnosis of affections about the root ends of teeth expressed in *x*-ray pictures to those who may be better qualified and are more familiar not only with the pictorial expressions, but with the anatomic structures, the history and symptomatology, however slight the latter may be.

The right to classify blind abscesses as being a source of oral foci of infection, although the correctness of the theory is generally claimed to be an established fact, is, to my mind, not nearly so clearly scientifically proved as is the probability of alveolitis being a source of oral focus of infection. Clinically, the results achieved by the removal of these blind abscesses in such cases in which their association with other bodily diseases are thought to be the primary source of infection are discouraging. Beneficial

results are found not nearly as frequently nor as spontaneously as in the removal of more superficially located foci of infection in connection with general bodily diseases such as are found in alveolitis pockets. I do not wish to belittle the possibility of these blind abscesses as being foci of infection, but I am not at all convinced that these or similar foci of infection are responsible *directly* for other secondary infections, notwithstanding the fact that they are frequently found in association with arthritis, endocarditis, cholecystitis, and a hundred other diseases. They are even *more* often found in the mouths of patients who show no expressions of any systemic disturbances at all. Rosenow has carried on a good many interesting experiments along the lines of proving such foci of infection to be *directly* responsible for certain diseased conditions, and while I am a great admirer of his wonderful knowledge and skill, I am not convinced of the correctness of his findings. To take the contents, for instance, of these abscesses (or from other oral foci of infection), cultivate them in the laboratory on artificial media, and then to inject a syringeful of an emulsion obtained therefrom into the abdomen of an animal, with the result that the animal shows arthritis, endocarditis, etc., is to my mind no proof whatever that such a relationship exists in the human body, where conditions are entirely different from any of these described in his experiments in the laboratory. In the mouth these abscesses are created very slowly and are usually of many years' standing. If in the course of time organisms or toxins are very gradually passed out into the system through a very circuitous route, I grant that they *might* set up a low-grade secondary infection. It would, however, appear to me that this very gradual infiltration of toxic material should tend to produce a greater tolerance and also an inhibitory antibody production. The possibility of the infectious nature of all foci of infection is so great, however, that dentists in general should do all in their power to prevent the creation of such foci, and if present, should use their skill to promptly remove them.

In conclusion, I believe that oral foci of infection are harmful; I believe that they create a low-grade secondary infection which permits other infection easily to obtain entrance and a firm hold

on the host. I do not believe that these foci of infection contain organisms *directly* responsible for *distinct* secondary infectious diseases. I believe that the toxins and organisms absorbed from pus surfaces in the mouth may so undermine the resistive power of the organism in general that it is laid open to easy infection, and that such foci create a condition favorable to the development of other diseases. I believe, in addition to local treatment in certain cases, the use of autogenous vaccines, as recommended by Medalia, tend to overcome this low-grade *secondary* infection, and *thereby* gives the system a chance to recover from other infectious diseases present, and I think that the great variance in the beneficent results from autogenous vaccines given in these cases lies in the fact that the vaccine obtained does not contain the particular organism which on account of its selectivity produced the particular bodily disease present. Further, I believe that these vaccines produce their good results by the fact that they contain such organisms which have prepared the way by breaking down general barriers (so that the real harmful agent could have full swing), and that by the destruction of these primary foes which broke down these resistive barriers, thereby again allowing the general antibody production and power of resistance to rise again, the *real* organisms of the disease can be handled by the natural antibodies present in the individual (no longer lowered in general vital resistance).

In the numerous cases which I have observed clinically I find myself more and more convinced of the fact that none of the various oral foci of infection contain distinct organisms which are *per se* responsible for distinctive general diseases. It is surprising how quickly and thoroughly individuals whose vitality has been wrecked and lowered by infectious oral conditions respond to the removal of these foci of infection. Patients complaining of malaise, headaches, insomnia, digestive and nervous disturbances express themselves as feeling tremendously improved in general health after scientific treatment of their teeth, gums, and surrounding structures by competent dentists.

To my mind the presence of oral foci of infection produce as a result of their presence a low-grade secondary infection generally,

and lower the host's opsonic index to various infectious organisms, but do not *per se* cause the occurrence of distinct bodily diseases. Their prompt removal is followed immediately by a rapid return of vital resistive power to the individual, which resistive power may be accelerated by the addition of autogenous vaccine treatment in such cases where physicians deem it advisable to bring about a more rapid change to the normal.

CLINIC OF DR. SOLOMON STROUSE

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INANITION IN THE TREATMENT OF DIABETES MELLITUS[1]

Historical Review. Principles Involved in the "Allen Treatment." Selection of Cases. Prognosis with Present Methods.

WHAT may be termed the crest of the food-inhibition wave in the treatment of diabetes was reached in 1914 when Dr. Frederick M. Allen published his first paper in which he advised the use of starvation in practically all cases of diabetes. The American literature has since contained many references to this method, which has been called the "Allen Treatment," and it is fitting that we shall consider the various aspects of inanition in relation to diabetic therapeutics. Since the therapeutic principles emphasized by Allen were based on experimental work in animals, and since he has offered an improvement in treatment over treatments previously used, it seems appropriate for us to start our discussion with a brief historic review: first, of the experimental work on the pancreas, which has been the basis of the modern pathologic conception of diabetes; and, second, of the development of the dietetic treatment of diabetes to its present state. Naturally, only the most prominent contributions will be referred to.

The colossal research of Minkowski and von Mering is the foundation of all subsequent experimental work. In 1889 they

[1] Based on a paper read before the Chicago Society of Internal Medicine, Nov. 27, 1916.

showed that complete extirpation of the pancreas in the dog resulted in diabetes corresponding to the severest type of diabetes in man. In their animals sugar secretion began four to eight hours after operation, and despite starvation the diabetes progressed to a fatal issue.

In a second publication (1893) Minkowski developed a technic for partial extirpation. With three of his partially depancreatized animals, in which one-eighth or one-twelfth of the gland was left, a sort of alimentary glycosuria resulted which he considered comparable to the mild type of diabetes in man. One dog developed glycosuria only after the ingestion of grape-sugar, while a pig showed sugar only on a bread-and-meat diet, a reduction on meat alone, and freedom of sugar on starvation for two days. From these experiments Minkowski concluded that partial removal of the pancreas produced a mild degree of the same disturbance which was observed to the highest degree if the pancreas were completely removed, and he further suggested that the mild forms of diabetes in man can be referred to disturbance of the function of the pancreas in the same way as severe cases.

As for the theory of action of the pancreas in his dogs, Minkowski states that "Normally the pancreas has some special function in the use of sugar, and the absence of this function is the cause of diabetes; that this influence of the pancreas is probably a ferment action is a contention which is considered not improbable from the experiments. However, the ferment action need not be 'glycogenic,' but can, for example, be explained in this way: With organs utilizing sugar in the normal way the pancreas acts by 'loosening' certain affinities by which the sugar molecule is bound. Further, it is probably true that the sugar circulates normally in a loose combination, which makes the sugar not utilizable for oxidative processes, and that the pancreas is called upon to loosen this combination, and in this way makes possible normal oxidation of sugar." Needless to say he proved that this action was due to an internal secretion.

Perhaps the next most important communication along these lines was that of Sandmeyer (1895), who produced *delayed* diabetes following partial pancreatectomy with ligation of the duct. With

one of his dogs a definite effect of the diet in intensifying the diabetes was seen.

Let us turn for a moment to the older conceptions of treatment. Rollo, in the latter part of the eighteenth century, was probably the first to use dietary regulations approaching our modern conceptions. About 1825 Prout, an Englishman, advanced the doctrine that the quantity as well as the quality of food must be restricted. From that time until Naunyn much of importance developed, but to Naunyn, above all others, perhaps belongs the credit of placing the dietary treatment of diabetes on a sound basis. To Naunyn (1898, "Nothnagel's System") we owe the conception that in most cases the progress of the glycosuria is the result of the bad influence which the glycosuria exercises on tolerance, and further, that the object of treatment is to "strengthen the weak function." He was the first to advocate temporary undernourishment, although he, like most writers up to Allen's time, feared a persistent undernourishment. Still he showed that patients can live comfortably on a low caloric diet and even gain weight on it. The use of "hunger" days was advocated and practised by Naunyn even in the severest cases, and he, as well as von Noorden, emphasized the astounding effect of starvation on severe acidosis.

Woodyatt (1909) makes this statement: "The pancreas like other glands is capable of being stimulated into a state of fatigue. In diabetes it may be assumed that the pancreas is functionally weak." One of his later publications (1914) shows that he had been starving diabetics.

In 1901 Guelpa wrote a book in which he advocated, on the basis of a wrong theory, however, the use of starvation as a treatment of diabetics.

This brief sketch gives us a fairly definite historic and scientific background from which we can consider Allen's work. Allen's conception of treatment was based on his work on partially depancreatized dogs. He reduced the problem to a mathematic basis, and ascertained that by the removal of about nine-tenths of the pancreas a severe diabetes resulted, while removal of only seven-eighths produced a mild diabetes. He found that

the method of feeding produced a definite effect on the course of the disease. The mild diabetes could be made severe by a diet rich in carbohydrates, or could be kept maintained without glycosuria, provided the diet contained no carbohydrate, or at least only the amount within the tolerance of the individual dog. By feeding of carbohydrate or protein in amounts above the tolerance he could change a mild diabetes into a fatal diabetes, and the pancreas remnant then showed the same changes as were seen in severe diabetes. On the other hand, by the use of starvation and undernourishment he could keep glycosuria from appearing in the more severe cases, and these animals, although thin, were otherwise normal.

In his book on Glycosuria and Diabetes he emphasizes two conceptions: one that diabetes is a functional disease of the nervous system, the other that the average diabetic patient has almost as good a pancreas as anybody, and that his pancreas may do its normal work if relieved of abnormal influences which interfere with it. He says "that the disturbance of the pancreas is at least at the outset functional in nature and that the pancreas itself is largely or entirely organically sound is a conception which not only agrees better than any other with certain known facts concerning the disease, but also introduces a hope of therapeutic mastery over it."

Allen then went to the Rockefeller Hospital and began to apply to the treatment of patients the principle just outlined of maintaining pancreatic rest by diet. The diabetic patient is put to bed without food. If coma seems imminent the usual purging, alcohol, and alkali are employed. As soon as the glycosuria is stopped and the acidosis diminishes, which is usually in forty-eight to ninety-six hours, the amount of alcohol and alkali are reduced. The fast is continued twenty-four or forty-eight hours longer, depending on the patient's strength. The alkali is then stopped and feeding is begun. The first food given will contain from 10 to 40 grams of carbohydrate, usually in the form of green vegetables. Then carbohydrate, fats, and protein are slowly added and the tolerance for each established. Starvation is interpolated, if necessary, until both the glycosuria and the acidosis

have disappeared. In doing this the weight of the patient is not considered, and even after the temporary starvation no attempt is made to increase weight.

Allen's subsequent publications have in the main been recitations of results of the starvation method as applied to *all* classes of patients and to all degrees of severity of the disease, although most of the patients treated at the Rockefeller Institute have had the severest type of diabetes. He does not talk of a "cure" of diabetes, nor does he contend that his method of starvation increases tolerance in the severer cases. He "attempts to do the same things that the rational treatment has attempted previously, but to do that more quickly, more accurately, and thoroughly." However, he does speak of a "vision of a diabetes in which there is no glycosuria, no acidosis, no use for alkalies or other drugs, no complications, no gangrene, no downward progress, no coma, no death."

In order to produce this visionary state prolonged starvation of even the severest type of case until there is absence of glycosuria and acidosis, followed by a diet which will continue this condition even at the expense of body weight must be employed. Increase of weight or metabolism increases strain upon the internal pancreatic function, and for that reason is not permitted. Detailed instructions are given the patient which aim to keep him free from glycosuria and acidosis and at a low level of nutrition.

Recently Allen has urged the value of strenuous exercise in maintaining his ideal state for the diabetic.

In summary, then, we might express Allen's main contributions to diabetes as follows:

(1) He has extended the work of previous investigators on animals by more precise operative procedures, and established a therapeutic program on the basis of his animal experiments.

(2) He has emphasized in a forceful manner the importance of considering diabetes a functional disease of the pancreas.

(3) He has advocated prolonged starvation as the best method of rendering even the severest type of diabetes free from glycosuria and acidosis.

(4) He has advanced a radical departure from generally accepted practice by his insistence on maintaining freedom from glycosuria and acidosis even at the expense of body weight.

Speaking from the standpoint of treatment of diabetes, there are three phases to be considered in all cases: (1) Rendering the urine sugar free; (2) keeping it sugar free; (3) increasing tolerance. I shall, therefore, discuss our debt to Allen under these three headings. Allen has certainly *extended* the use of starvation beyond the general practice up to his time, and it is pertinent to inquire whether all patients can or should be starved to render them sugar free. Personally, I feel from my own experiences that *not all* patients with diabetes stand starvation well. The mild cases, who as far as their metabolism is concerned, more nearly resemble the normal than the diabetic, and who are easily made sugar free by simple reduction of carbohydrate intake, should be treated as of old by such simple reduction. Nothing is gained except perhaps a day or two by the more drastic procedures, tolerance is not increased to a higher level, and the patient is exposed to the potential danger of acidosis which threatens the normal person who is starved. Also there are certain complications, such as tuberculosis, cardiorenal disease, exophthalmic goiter, which at least increase the possible dangers of starvation. I have recently seen two patients with latent pulmonary tuberculosis flare up actively and progressively during starvation for their diabetes. In one nephritic I had to stop starving on account of a threatening acidosis. Likewise the obese diabetic, who in so many ways differs from the usual run of diabetic patients, has not, in my experience at least, done well under starvation.

For such reasons it has seemed to me unwise to starve all patients as a routine, and except in cases of threatened coma I still employ a preliminary period of observation and tests. This period occupies rarely more than two days, during which time the patient can be individualized, and if rapid withdrawal of food is indicated we can usually expect a brilliant reduction of ketonuria and glycosuria without fear of either increasing acidosis or of death by starvation. One group of patients seems especi-

ally to react favorably to immediate starvation—the young diabetic who because of overeating has induced the condition of severe acidosis verging on coma. One of my patients who lived in another city was doing so well on the diet prescribed that he thought he would go on a real food spree. After about a week of unrestricted diet he began to feel uneasy and restless. In another day he was listless, and when he finally realized he was suffering from an acidosis he came to Chicago, but when he arrived he was so "dopey" he would fall asleep while talking. Immediate starvation for two days produced a marked improvement. Yet in most cases it seems well to follow Joslin's advice to go slowly and reduce the dietary *fats* before completely removing carbohydrates.

But one fact in modern therapy emphasized by Allen, and especially by Joslin, seems to me of the greatest importance. By quickly freeing the patient from glycosuria and acidosis much of the hospital stay can be devoted to testing tolerance for all components of the diet and to instructing the patient in his after-care. For some men this may have been common practice, but I believe that, generally speaking, it has been neglected; and yet if a better prognosis is now offered the diabetic patient this therapeutic co-operation will be found responsible, for surely any increased tolerance is not due to the method of making the patient sugar free, but to the means of keeping him so.

Discussing now the second phase of treatment, keeping the urine sugar free, Allen believes that aglycosuria must be maintained at all costs, even at the expense of body weight. This is so decidedly at variance with practice generally employed that only the test of time will prove or disprove its value. Keeping a patient under continuous observation in a hospital is not by any means the same problem as having the same patient treat himself away from your direct control, and there are external dangers for the undernourished diabetic which cannot be disregarded. Foster believes that there are other factors in the handling of diabetic patients besides freeing the urine of sugar and ketone bodies, and is "frankly pessimistic for that group of cases that can attain and preserve sugar-free urine only at the expense of

nutrition." I am not so sure that the weight curve should be entirely neglected for the urine chart. If the continued aglycosuria means undernutrition and increased susceptibility to infections, it ought at least to promise in return a final increased tolerance.

With the milder cases of diabetes it is not difficult to raise carbohydrate tolerance; with the severe cases it is usually very difficult, and the ultimate test of improvement would seem to be increased tolerance. Starvation to render the urine sugar free increases tolerance only in that it quickly produces the condition of aglycosuria without which increased tolerance is impossible. If Allen's conception of diabetes as a functional disease is correct, a continuous aglycosuria will produce a final increased tolerance, except in those cases in which the functional disturbance has produced anatomic changes in the pancreas such as his dogs showed. There can be no question that many patients apparently severely ill react remarkably to treatment, and it is usually true that such patients have been sick for a comparatively short time. On the other hand, patients who have had diabetes, either not diagnosed or poorly treated for some time before rational treatment is begun, usually cause the greatest difficulty in increasing tolerance. Such patients generally will maintain a sugar-free urine only with the loss of body weight, and under usual methods of treatment do not show any marked increase in tolerance even after periods of sugar freedom. Persistent aglycosuria should mean to these patients a final improvement, not merely a prolonged stasis; but it will take time to decide the real value of inanition in this type of diabetes.

CLINIC OF DR. CHARLES LOUIS MIX

MERCY HOSPITAL

BACILLUS AËROGENES CAPSULATUS INFECTION OF THE INTESTINES

Report of a Rare Case with Persistent Fecal Fistulæ Caused by Bacillus Aërogenes Capsulatus Infection. Technic of Demonstrating the Organism. Treatment Based on Withdrawal of Carbohydrates.

December 12, 1916.

THE patient is a single man, thirty-seven years of age, who has been in Mercy Hospital since August 28, 1916.

Previous History.—During his childhood he suffered from diphtheria, measles, and mumps. The family history is negative. During the years 1909, 1910, and 1911 he had three severe attacks of pain in the pit of the stomach, each succeeding attack being more acute than the preceding one. The pain bore no relation to meals and lasted three to four hours. During and after the pain the patient was nauseated, but did not vomit. There was no fever. He took castor oil and applied mustard plasters, which gave relief. The last attack, on February 10, 1911, was so severe that a physician was consulted. Appendicitis was diagnosed and an appendectomy was performed on February 16th. A stitch-abscess developed a few days later and healed within a week.

Ten days after this operation the patient noticed a sensation of fulness and distention of the stomach with some increase in his temperature. The feeling of fulness continued for five to six hours after each meal, and would finally be relieved by vomiting. The bowels were not constipated. Soon after this chills and fever developed and examination of the blood revealed a leukocytosis.

This was followed by pain in the right arm, and the following day this pain moved down to the right chest, localizing after another day in the region of the liver. Induration resulted at this point. On March 14, 1911, he was operated upon for an abscess beneath the liver, a drainage-tube was inserted, and there was a purulent discharge which lasted four weeks.

The wounds healed and thereafter he was in good health until January 4, 1912, when following sudden exertion sharp pain developed in the lower right quadrant which resulted in a hernia immediately to the right of the appendiceal scar. He wore an abdominal support, but the hernia gradually increased in size. Another bulging appeared in the left inguinal region in the fall of 1914. He was operated upon for this double hernia on August 3, 1915. No pus was found. During the following four days there was an obstruction of the bowels, accompanied by a rise in temperature, but without chills; on the fourth day after the operation he had an attack of violent hiccup.

On August 7, 1914, four days after the double hernia operation, the fourth and last operation before entering Mercy Hospital took place. At this time an incision was made in the median line, from the umbilicus down, and pus was found. The bowels were in an abnormally distended condition, a portion of the bowel was gangrenous, and 3 inches of the small intestine were resected. An end-to-end anastomosis was made by means of the Murphy button[1] and a drainage-tube inserted. A discharge consisting of purulent and fecal matter followed. There were chilly sensations and fever for the next two days, when the median incision broke down and there was a profuse fecal discharge which was followed by peritonitis. Subsequently both hernial incisions on the right and left sides broke down and discharged purulent and fecal matter profusely for four weeks. At the end of this time the right hernial incision healed, but the left continued to discharge pus and a fecal fistula remained in the median line. The patient had had no bowel movement per rectum since August 8, 1915.

He was admitted to Mercy Hospital on September 21, 1915, and was operated upon by Dr. John B. Murphy on September 28,

[1] In the presence of pus a Murphy button should never be used.

1915. The patient's case is reported in the MURPHY CLINICS, Vol. V, No. 3, June, 1915, p. 465. At the time of his admission the feces were all escaping through the middle fistula, but there was a purulent discharge without feces from the left hernial incision. Injections of methylene-blue escaped through the median fistula, showing that it was not far from the sigmoid flexure. Dr. Murphy's report of the operation follows:

"After exposure of the abdominal contents it was found that from ulceration a large opening about 3 inches in length existed in the caput coli, and that the small intestines were involved in numerous adhesions, with a transverse communication between two coils on the left side, at the site of the button-anastomosis, the button resting upon one of the coils. With difficulty the intestine was freed from adhesions to the anterior abdominal wall, the button was removed, and, using a Czerny-Lembert suture of chromic catgut, an anastomosis was made at the site of the second fistula. The opening in the cecum was closed, and the ileum was brought over and stitched laterally to give support to the line of union, whereupon the approximation appeared to be very secure. Drainage was established by means of rubber tubes; sponges and instruments were accounted for, and the wound was closed under great tension by figure-of-8 through-and-through sutures. An intravenous infusion of a liter of normal saline solution was given on the table. A rectal tube was inserted to prevent accumulation of gas in the large bowel. The operation consumed three hours, but the patient left the table in fairly good condition.

"Ten days following the operation there was a pus discharge from the mid-wound, and five days later feces appeared. He had been having, however, frequent bowel movements *per rectum*. He was then given some *x*-ray treatments and the fecal fistula closed. Four weeks later another point of suppuration appeared, and again there was a fecal leakage, which finally closed completely. The patient left the hospital January 13, 1916."

On questioning the patient concerning the postoperative history after the operation by Dr. John B. Murphy of September 28, 1915, we learn that on October 3, 1915, pus discharged freely from the drainage-tube in the center and from the left inguinal incision.

On the 5th there was a fecal discharge through the rectal tube. On the 9th there was profuse fecal discharge from the middle and on the left side. On the 21st the rectal tube was removed. On October 26th he had his first bowel movement *per rectum*, and following this there were slight daily evacuations after low enemata.

On November 15th *x*-ray treatment was instituted, and on November 18th he had retention of feces. The temperature at this time rose to 103.8° F. and the pulse reached 140. A cathartic was administered and both wounds opened wide. On December 2d a phlebitis developed in the left leg. On the 12th the middle sinus closed, the left continuing to discharge feces. On the 23d the patient sat up for the first time in five months.

On January 13, 1916, he left the hospital. At that time the middle sinus had been closed for nearly six weeks. The left sinus was still discharging fecal matter. The intestinal condition was fairly good, but there was a slight tendency to constipation which was relieved by administering mild cathartics. A few days after the patient returned to his home he began to be distressed by intestinal gases, and this condition was accompanied or immediately followed by diarrhea. He took castor oil, which relieved the trouble for a few days only. After one or two weeks of this perturbed intestinal condition the middle sinus, which had been securely closed, broke open. It remained open for ten days, and then closed again for a few weeks, not as securely, however, as in the first instance. In the meantime the intestinal disturbance, the diarrhea and gases, were increasing, cathartics giving only temporary relief. The patient noticed that an extremely aggravated intestinal condition was in nearly every instance concomitant with the reopening of the middle sinus. Whenever the bowel condition was good the middle sinus would close and he would gain 3 or 4 pounds a week in weight, which would be lost again whenever the disturbance recurred. From the 1st to the 5th of June, 1916, the bowels were quiet and both sinuses closed, but about June 5th the usual intestinal disorder came on again. On June 6th the left sinus opened and this was followed by an opening of the middle sinus four days later. Bismuth and other

sedatives administered would give relief for a few days only and become ineffective thereafter.

On June 20, 1916, the patient was put to bed and placed on a milk, toast, and egg diet, of which he partook rather sparingly. He remained in bed until the 30th of June. During these ten days the left sinus closed, remained closed for four days, and then reopened. The middle sinus closed on June 26th. Two days later an induration appeared 1 inch above the former middle sinus in the scar of the median incision, and a new sinus which discharged fecal matter appeared in this place, thus making three discharging points. On June 29th a large dose of castor oil was administered, and after the thorough cleansing out the patient felt much improved.

July 5, 1916, he went to a Kneipp Sanitarium. Here he slept out-of-doors, and mild cold-water treatments were given to stimulate the general upbuilding of the system. During the first three weeks of this treatment he gained 15 pounds in weight. Concomitantly with the excessive heat at the beginning of August, 1916, there was a recurrence of the former intestinal disorders in a very acute form. The patient suffered from acute diarrhea, intestinal gases, and severe griping pains, the pain coming on like waves every ten to fifteen minutes or oftener. The patient returned to Mercy Hospital August 28, 1916. At this time he had a temperature of 101° F. and the bowels were in a turbulent condition. Lactic acid (a Metchnikoff culture) was prescribed and twenty (7 c.c.) tubes gave marked relief. A tuberculin test was negative.

On September 14, 1916, Dr. E. Wyllys Andrews operated upon the patient. The opening in the left iliac fossa was found to lead into the descending colon, which was not narrowed. This sinus was closed. The two sinuses in the midline were found to communicate with a knuckle of small intestine firmly adherent to the anterior abdominal wall. This condition was remedied and a possible obstruction from angulation obviated, though the firm union of the knuckle to the anterior abdominal wall was not separated. A rectal tube was inserted.

On September 15th, the day following the operation, fecal

matter burst through the wound in the left iliac fossa. On September 18th the rectal tube was removed and on the 20th he had the first bowel movement *per rectum* by means of an enema. Thereafter there was a daily movement *per enema.* On September 22d the middle sinus opened at both its upper and lower openings and this was followed by a profuse discharge of pus and feces, though not so profuse as that from the left iliac opening. On October 12th a series of *x*-ray treatments was proposed and begun.

Comments by Dr. Mix.—During the early part of October, 1916, the bowels were very much distended with gas and there was a good deal of diarrhea. On October 17th the patient was referred to me by Dr. E. Wyllys Andrews for any suggestion that might possibly be made to restore him to health. The patient at this time made a remark which seemed to me quite *apropos.* He said that it seemed to him the surgeons were trying to put a patch on an inflated inner tube. By this he intended to convey the idea that the intestines were so distended with gas that it was impossible to close them. It had occurred to him after watching his case for many months that if the intestines could be freed of these gases he would automatically get well. This gaseous condition was, moreover, associated with a very obstinate diarrhea. This had been previously investigated, but no cause for it had ever been satisfactorily found, and it was supposed to be due merely to his general condition and to his fecal fistulæ.

The association of a very obstinate diarrhea with a good deal of intestinal gas ought always to bring up the possibility of an infection with the *Bacillus aërogenes capsulatus.* This bacillus gets into the duodenum and small intestine where it works in an alkaline medium, thriving altogether upon carbohydrate pabulum. Having had a previous case of *Bacillus aërogenes capsulatus* diarrhea, instructions were at once given that the bacillus be sought for in the laboratory. This is very easily done by making a culture in milk in a test-tube. A loopful of feces is mixed in 5 c.c. of unskimmed milk in a test-tube, and heated to 80° C. for twenty minutes. This kills off all the bacteria present except spore forms. The test-tube contents are then incubated at 37° C.

for twenty-four hours. At the end of this time the milk is coagulated and all "shot to pieces," and through the casein is to be seen a pinkish color, which is essential to the perfection of the test. About seven different organisms will produce the effect in the milk and casein, making it look "shot to pieces," but only the *Bacillus aërogenes capsulatus* will produce the pinkish tinge in the casein.

A further confirmation of the presence of the *Bacillus aërogenes capsulatus* can be obtained by killing a rabbit and immediately injecting into its ear-vein a culture of the germ. The rabbit is put into a warm place, and usually by the next day it will be tremendously distended. Indeed, in one of our cases the abdomen of the rabbit actually blew up. By this means we promptly established the existence of this rather unusual form of intestinal infection, of which not very many cases have as yet appeared in medical literature.

My attention was first called to this *bacillus* in connection with infection of the duodenum and small intestine by Prof. Arthur I. Kendall of the Northwestern University Medical School. Previous to his coming to Northwestern as Professor of Bacteriology he had done at the Boston City Hospital a large amount of work upon the diarrheas of babies, and had found that numbers of inexplicable diarrheas in marasmic babies were actually caused by infection of the intestines with the *Bacillus aërogenes capsulatus*. It is his technic which we have followed in demonstrating the bacillus by cultures with milk and by culture in the rabbit.

Prof. Kendall and others in their study of the *bacillus* established the fact that it depends absolutely for its nourishment upon the carbohydrate pabulum. I have learned by my own observation of this bacillus in clinical cases that it is possible for it to derive nourishment from starches and sugars of whatever type. It thrives on the lactose of milk, so that milk, if given to babies and adults with this disease, increases the diarrhea rather than diminishes it. It is like putting out a fire with gasoline. It can also thrive on very small amounts of carbohydrates, such as are to be found in spinach and asparagus, although this amount

is only 3.7 and 3.9 per cent. respectively. Still, it is ample for the propagation of the germs.

Treatment.—The diagnosis having been established within two days' time, the patient on the 19th of October was put upon a diet which was almost exclusively protein. We made the mistake, however, of permitting him to have spinach. This we did in the hope and expectation of preventing an acidosis. We were subsequently compelled to abandon the use of spinach and asparagus because we were not getting results.

On October 25th the laboratory examination of the feces again revealed the presence of the *Bacillus aërogenes capsulatus* in large numbers. On the 29th, ten days after the protein diet had been instituted, the acidity of the urine was 144 as against a normal 40. He was, therefore, given 1 ounce of glucose dissolved in 1 quart of normal salt solution intravenously. The day following the acidity of the urine was reduced to 104 and ultimately declined to 40.

About one month after the injection of the glucose intravenously the urinary acidity again rose to 100, and a second injection of 1 ounce of glucose intravenously was given. Once more this immediately reduced the acidity from 100 to 40, at which level it now is. During the time intervening between October 19th and the present the patient has lived exclusively upon proteins and hydrocarbons. He has had all the fat meat and all the butter that he has wanted, but not one grain of carbohydrates has been given to him since the asparagus and spinach were stopped. Yet there is no acidosis. Why would it not be possible to cure scurvy by intravenous injections of glucose?

I have wondered whether it is not possible for the *Bacillus aërogenes capsulatus* to convert cellulose into sugar and so to make use of it as a pabulum. Certain bacteria have this power, and it would be by no means strange if the bacteriologists should discover that the *Bacillus aërogenes capsulatus* also possesses it. The injection of glucose into the blood, of course, makes possible the reaccumulation of glycogen in the liver and the restoration of liver glycogen undoubtedly prevents the development of acidosis. There seems to be no opportunity for the *Bacillus aërogenes capsu-*

latus to get hold of the glucose so injected and to use it for a food. The patient, who is in great need of the carbohydrates, can get them intravenously, while at the same time the germs are deprived of them. There is no reason why the glucose, if given intravenously in normal salt solution, should not be given as frequently as his urinary acidity seems to demand it.

Another important factor in ridding the duodenum and small intestine of the *Bacillus aërogenes capsulatus* is lactic acid. The best way to bring about the desired end is to have the patient take upon an empty stomach a tube of lacto-bacilline twice daily. This was also given to the patient, and he has been kept upon it steadily.

By November 1st, just twelve days after dietetic treatment was begun, there was already a marked reduction in his diarrhea and in his gas formation. At times he had formed stools, the first in months and months. On November 2d Dr. Andrews injected scarlet red paste into the sinuses in an endeavor to lead to their permanent closure. The middle sinus closed superficially and reopened after two days. The left iliac sinus reopened slightly after having been closed for four or five days, but again closed, and has remained closed ever since that time. When I first saw the patient he was wearing an attachment for collecting the feces from the left iliac sinus, and in the cup there were nearly 2 ounces of fecal matter. Within one month's time the large left sinus which opened into his colon was entirely closed and has remained closed up to the present. The middle sinus at first was double. The lower one of the two sinuses is now entirely closed and has been closed for about three weeks. The upper opening of the sinus is at the present time closed, but from time to time it has reopened to permit of the forming of a crust of serum over the orifice, but not to permit of the escape of feces. At the present time all of the sinuses are closed to feces, and we expect to dismiss the patient from the hospital in time for him to go home for the Christmas holidays.

The importance of this case lies in this fact: It illustrates very conclusively that it is possible for a fecal fistula to be caused and continued by infection of the intestine by the *Bacillus aërog-*

enes capsulatus. So far as I know this is the first case on record in which this particular germ has made impossible the closing of fecal fistulæ. It is not unlikely that there are other cases and that the lesson learned from this case may be of advantage in future work. Surely in the presence of an obstinate opening from the intestines to the exterior in which there is an abundance of gas formation and diarrhea the examination will not be complete unless the *Bacillus aërogenes capsulatus* is tested for.

NOTE.—January 2, 1916. Extract from a letter of this date: "The left sinus reopened last Thursday and discharged very freely for a few days, but it seems to be shrinking again. The middle is pretty well closed again. The bowels are still inclined to be loose. We are injecting scarlet red paste every second day." The infections of the intestines by the *Bacillus aërogenes capsulatus* are very hard to cure in adults, but a cure can be effected with perseverance.

ANEURYSM OF THE AORTA

Discussion of the Symptoms and Physical Signs in an Atypical Case. Diagnosis Verified by Röntgen Examination. Clinical Manifestations and Pathogenesis of Aortic Aneurysm and Aortitis in General. Prognosis and Therapy.

December 19, 1916.

Present History.—This patient is a male, forty-eight years of age, married, no children. He complains only of coughing and shortness of breath after violent exercise or overexertion. His trouble is aggravated when he gets a cold. Mucopurulent material collects in his bronchi and he raises it in comparatively large quantities. He has just recovered from such an attack, and it has so disturbed him that he seeks medical advice.

He took his last cold recently in a sleeping car, and was laid up for a week with high fever. At this time he coughed up a lot of mucopurulent material with difficulty. At first it was rather yellow, but as he began to get better it became white. At times the sputum has been blood-stained. He says that during the attacks his chest fills up with the material and that after the cold is over he expectorates only a moderate amount. The odor of his breath does not get bad during the attacks, as it does in the ordinary cases of fetid bronchitis. Although he has fever with the attacks, he has none between them. His appetite, which is poor at the time of the attack, is pretty good at other times, especially when he is able to be out-of-doors and take exercise.

He complains of shortness of breath, but has never noticed any swelling of the feet or ankles. He has no pain in his chest, no soreness or tenderness in any location. He rises in the night to urinate and has been doing this for several years, but repeated examinations made by physicians have never shown albumin or casts. His bowels are always regular. There is no history of joint troubles or headaches. Cross-examined on the matter of aches and pains in his chest, he says there are absolutely none

present, and that he has never been able to detect a sore spot in his thorax. He used to be quite a hard smoker, but recently, on account of his thoracic condition, he has given this up. He has never been a user of alcohol.

His present weight is 142 pounds as compared with a maximum of 159 four years ago.

He first saw a physician in July, 1914, at which time he weighed from 150 to 155 pounds. Since then he has had numerous attacks of coughing with the raising of considerable amounts of sputum. Repeated examinations of the sputum did not show any tubercle bacilli. He entered the hospital because of the fear on the part of his friends that he had pulmonary tuberculosis.

Examination of the patient shows a number of interesting things. Perhaps the most remarkable of all is the effect of posture upon his breathing. When he lies down flat upon his back breathing is with evident effort and is rather wheezing in character. When he sits up, breathing is easier and the wheezing disappears. As soon as he lies down again the trouble begins anew. Therefore it is necessary for him while sleeping at night to have his thorax at an angle of about 45 degrees. This seems to make for freedom of breathing.

Another interesting point connected with posture is that when he lies down he has a choking sensation, coughs more, and brings up more sputum. As soon as he sits up the cough is relieved and the sputum stops coming.

Inspection of the thorax shows no surface abnormality. There is a moderate degree of epigastric pulsation and a visible apical pulsation in the fifth interspace at the nipple line. There is no visible pulsation in the suprasternal notch.

On *palpation* one is aware of a mildly diffuse apex-beat, suggesting a very slight hypertrophy of the heart or a very moderate dilatation. However, pulsation can be felt in the second right interspace, a place where pulsation, as a rule, ought not to be felt. There is, nevertheless, no expansile pulsation over the chest and no heaving of the chest wall.

Percussion shows a large area of dulness. Beneath the clavicle on the right side is an area of dulness extending over toward

the midline of the body. It is exactly like the dulness obtained over a tuberculous lung. Percussion of the mediastinal area shows an area of dulness considerably larger than normal. For example, in the second right interspace dulness is quite marked. This used to be called *Huchard's sign*, and suggests dilatation of the arch of the aorta. There is also present an area of dulness extending well to the left of the sternum. This dulness is fairly wide-spread and quite symmetric in distribution, extending no more to the right than it does to the left, and reaching up as high as the middle of the first piece of the sternum.

Auscultation of the heart sounds reveals no reversal of accentuation at apex or base. The heart tones at the apex are normal in quality and apical murmurs are absent. Auscultation at the base shows no systolic or diastolic murmurs, but does show a remarkable clearness of sounds with a considerable degree of aortic second accentuation, which sounds very close to the ear in the second right interspace. On palpation a diastolic shock is very apparent. Examination of the lung shows a certain amount of bronchial breathing close to the area of dulness on the right side, but none in either apex. Posteriorly the heart tones are not to be made out and the lung findings are quite negative.

Examination of the pupils shows them to be equal. The radial arteries show neither asynchronism nor asymmetry of the pulse. The blood-pressure of the right and left radial shows a difference of only 3 m.m. Palpation of the two common carotids shows that they fill at the same time and with the same pressure. There is no tracheal tug. There is no hoarseness, and examination of the vocal cords shows no paresis of either of them. He has never had difficulty in swallowing.

Diagnosis.—With the data which we have at our command there is only one likelihood present, and that is the probability of either an aneurysm or a mediastinal tumor. Nothing else can quite explain the symptoms. A mediastinal tumor resting upon the bifurcation of the trachea, or an aneurysm so placed as to interfere with the trachea and its bifurcation, beautifully explains the difficulty which this man experiences with his breathing apparatus when he attempts to lie down. The most obvious

inference is that a weight of some sort, when he lies upon his back, gradually compresses the two great bronchi, right and left, and so produces the wheezing. When he sits up or leans forward slightly, which is the position most favored by those suffering with pericarditis, the pressure upon the trachea and the bronchi is released and breathing is easy once more. Moreover, such a hypothesis of tumor or aneurysm explains his varying colds. It is not difficult to imagine that a varying degree of infection of the great bronchi might result from a varying degree of compression and a varying degree of ventilation of the lungs.

Against the diagnosis of aneurysm, however, is the complete absence of pain. The patient absolutely insists that he has never had a particle of pain or of tenderness in his thorax, although he was repeatedly questioned in this respect. Notwithstanding the absence of general signs of aneurysm, especially the absence of an expansile tumor, of a palpable thrill, of pupillary inequality, asynchronism, and asymmetry of the radial arteries, dysphagia, tracheal tug, and either systolic or diastolic murmurs, aneurysm seemed to be the only possible diagnosis. We, therefore, had an *x*-ray made stereoscopically so that we might have a clear picture of the conditions of the thorax. This shows a very large, multiple, sacculated aneurysm lying above the heart, which is flattened out upon the diaphragm. It is almost as though the patient had two hearts, an upper aneurysmal one and the lower real one, which can be easily distinguished in the plate. Absence of signs of pulmonary tuberculosis will be noted in both apices, and even the rather usual peribronchial streaming is not present.

When one makes the diagnosis of aneurysm in a married man of about fifty years of age without children one is almost at once driven to the conclusion that the usual syphilitic etiology will turn out to be present. Cross-examination, however, of this patient shows that he has led a perfectly clean life. He has never had a Neisserian infection and has never had a chancre. No scars are to be found indicating the existence of a former chancre. You will note, however, that upon the left side of his chin is a very peculiar scar, and it was the observation of this scar which led to a peculiar bit of history. From some source, he does not

Fig. 155.—Stereoscopic roentgenogram showing large sacculated aneurysm. Remove plate, mount, and examine with the stereoscope.

know what, his lip became infected more than twenty years ago, and a series of thickened ulcers with enlargement of the glands of the neck appeared on the left side of his chin. The glands involved were those beneath the angle of the jaw. He tells us that after a long period of time this got well and, although he had never taken any treatment for a syphilitic infection, his family doctor insisted that the trouble with his chin was luetic, but that he had never believed it. An examination of his blood was, therefore, made at once with five different syphilitic liver antigens, and all five of them gave a frankly positive Wassermann reaction.

Etiology.—According to our statistics 75 per cent. of all aneurysms occurring between the ages of thirty-five and fifty are syphilitic in origin. If I were to give my own personal opinion of the number of syphilitic aneurysms between those age limits I should place it considerably higher. The spirochetes are particularly prone to settle in the aortic wall or about the aortic valves. Whenever one encounters a case of aortic insufficiency in a man in his forties without antecedent mitral disease, the chances are almost one hundred to one that it is syphilitic in origin. Strümpel called attention to this more than twenty years ago, insisting that the great majority of aortic insufficiencies occurring at this time of life were on a specific basis, and also published several cases showing an association between aneurysm and tabes in proof of his contention. Since the late nineties cases have so multiplied that it is now a safe assumption that all cases of aortic disease not associated with mitral valve lesions are luetic unless proved otherwise. This case, although at first sight apparently non-luetic, is no exception to the general rule when carefully investigated.

The **symptomatology** of aneurysm may be divided into the symptoms proper and the physical signs. Of the symptoms proper, those of greatest importance are cough, dyspnea, and pain. Their onset, as a rule, is in the order named. The first symptom met with is usually cough. At first it is loud, ineffectual, often paroxysmal, and, as a rule, ascribed to bronchitis. In the later stages it becomes metallic, brassy, and so characteristic that one may make a diagnosis of aneurysm if one is familiar with its sound

by simply hearing the cough. After the cough has lasted for a variable length of time dyspnea occurs. It is usually brought on only by exertion, and differs from ordinary cardiac dyspnea in that it is not associated with swelling of the feet or ankles or signs of cardiac weakening. As a rule, it is a dyspnea *out of proportion to the cardiac findings*, and is suspicious on that account. The third symptom which is added is that of pain, and upon this subject I wish to amplify somewhat.

In general the pains of aneurysm are of two sorts—the anginal pains and what might be called the pressure pains. The anginal pains are frequently very early. I know of one case in which the diagnosis of angina pectoris was made and in which six years later an unmistakable aneurysm developed. If Clifford Allbutt is right in his contention that the only constant finding in an angina pectoris is an aortitis, then we ought to expect anginal symptoms in aortic aneurysms quite commonly. As is well known, these pains are very frequently present. The anginal pains are not confined to the precordial area, but often pass over into the left arm, through the intercostohumeral nerve, and even into the right arm, especially in aneurysms of the ascending arch. Supraclavicular pains of the anginal type are by no means uncommon. These may occur on the left or right side, and in general bear some relation to the location of the aneurysm. Not infrequently there is pain in the territory of the cervical vertebræ and of the small occipital nerves. These are undoubtedly cases of referred pains made possible by reflexes due to the connections between the sympathetic aortic plexus and the spinal nerves.

A very characteristic feature of these anginal pains of aneurysm is their occurrence during the night. It is a well-known fact that the pains of syphilis are nocturnal or vesperal, and syphilitic aneurysm by no means disobeys the rule. When, therefore, a patient complains of anginal attacks coming on chiefly in the night one ought not to assume that they are due largely to posture, but one ought rather to inquire whether they might not be due to syphilitic aortitis.

Besides the anginal pains common in the early stages of aneurysm there are definite pressure pains which are to be found

in the later stages. These are usually described as burning or boring in character, and not at all anginoid. Their location is usually thoracic, but not infrequently they are felt in the back, and are referred along the intercostal nerves. They may even in cases of aneurysm of the descending arch appear in the abdomen and the small of the back. In cases of erosion of the vertebræ or of the sternum pains are very common from such sustained pressure of the aneurysm. These pains are quite different from the paroxysmal anginal pains. They are more insistent and continuous than paroxysmal. So common is pain either of the anginal or the pressure type in aneurysms that one is apt to believe that pain is a *sine qua non* in the diagnosis, but such is not the case, as is proved not only by this patient but by many other cases on record.

Besides cough, dyspnea, and pain, aneurysm produces other signs which disturb the patient, the chief of these being hoarseness and difficulty in swallowing. The difficulty of swallowing is seldom serious and rarely, if ever, involves the swallowing of fluids. As a rule, it is only solids which find difficulty in passing into the stomach. Hoarseness is a very common complaint, being present in perhaps 40 per cent. of the cases, and usually of gradual onset. It may, however, appear very suddenly. A sixth subjective complaint on the part of the patients is vertigo. Vertigo, as a rule, is an unusual symptom in aneurysm, but Cabot reports a case on page 142 of the second volume of his Differential Diagnosis in which the patient, a woman of fifty-two, entered the hospital chiefly on account of vertigo. Cabot, in commenting on this case, calling attention to the usual etiology, namely, syphilis, says: "That cause, syphilis, has probably produced also changes in the cerebral arteries whereby the amount of blood passing through them does not vary as it should, according to the demands of the moment. One can well conjecture that such vascular changes would produce vertigo."

Late work done by otologists on the subject of vertigo has brought out some interesting facts. It has been discovered that in arteriosclerosis very many attacks of vertigo are due not to arteriosclerosis of the cerebral arteries or to possible cerebral

ischemia, but rather to an arteriosclerotic aortitis. It seems that in arteriosclerosis of the arch of the aorta perverted impulses through the pneumogastric are responsible for the attacks of vertigo. If these investigations are correct, and I believe them to be, then we must look upon the dizzy attacks of old people with arteriosclerosis as indicating a probable aortitis.

In this connection it might well be asked whether the cause of very sudden death in angina pectoris where there is well-marked aortitis is not due to reflex cardiac inhibition through the pneumogastric nerve. No adequate explanation for sudden deaths in angina pectoris has ever been advanced, so far as my knowledge goes. Would it not be possible for sudden cardiac paralysis to take place as a reflex pneumogastric phenomenon occasioned by disease of the aortic wall? Sir Clifford Allbutt takes the position that the only constant lesion in cases of angina pectoris is to be found in disease of the aorta. He says, in sustaining his position, that the old theory of coronary sclerosis had to be abandoned because of the absence of uniform findings of coronary blockade in postmortem examinations of anginal victims. Therefore the theory of coronary spasm was invoked, but this has also proved untenable, the only constant finding being the aortitis. Now, if such aortitis can give rise to paroxysmal vertiginous seizures, why would it not be possible for fatal cardiac paralysis to supervene as a reflex from the aortic arch through the cardiac inhibitory fibers in the pneumogastric nerve?

The *physical signs* of aneurysm are, in order of importance, an expansile tumor, dulness extending beyond the usual cardiac area in the upper mediastinum, a palpable thrill, a diastolic shock, alteration of the aortic second sound, pupillary inequality, asynchronism and asymmetry of the radial arteries, and tracheal tug. Any or all of these signs may be absent and only the *x*-ray may be potent in establishing the diagnosis. Although this man has an enormous aneurysm, he positively has no pulsating tumor. Although his aneurysm is so large that it would seem incredible that he does not show a palpable thrill, nevertheless none can be found. He shows, moreover, on auscultation no systolic murmur over the area of dulness, and there is no aortic insufficiency as shown by a

diastolic murmur. The only auscultatory phenomena which he shows are an undue accentuation of his aortic second sound and an unusual closeness to the ear of the first and second sounds at the base of the heart. There is no systolic murmur to be heard in his back, such as frequently appears in many aortic aneurysms; by palpation, however, he shows a well-marked diastolic shock, a symptom not made much of in American text-books, but figuring prominently in those of German origin. Although pupillary inequality is present in at least 40 per cent. of aneurysms of the transverse arch, there is no pupillary inequality in this man's case. His radial arteries are alike in time and tension. There is no paralysis of either recurrent laryngeal nerve, and although one might confidently expect that he would show a tracheal tug, when you grasp the thyroid cartilage and slightly pull up upon it you are conscious of no tugging downward.

In other words, although this man has a large aneurysm, practically his only symptoms are cough, dyspnea, and expectoration, and his only physical findings are an increased area of midthoracic dulness and an alteration in his aortic second sound.

Treatment.—The patient upon being admitted to the hospital was immediately placed upon a mixed treatment consisting of hypodermics of succinimid of mercury in $\frac{1}{3}$-grain doses These may be given daily; they cause no induration and are not painful. They are far less objectionable to the patient than gray oil or bichlorid of mercury or even salicylate of mercury. He has also been given thus far one dose of neosalvarsan intravenously. He will be given four other doses at intervals of approximately two weeks. After he is in somewhat better shape physically it is my intention to have him spend the winter in the South, where he can largely recover from the cough and expectoration, which are due quite as much to the chronically inflamed bronchial mucous membrane as to the aneurysm itself. We shall, of course, continue vigorous antiluetic treatment for a periof of two or three years' time. We do not hope ever to cure the aneurysm. The most that we can hope for is to prevent its further development, and to assist by our antiluetic treatment and by the iodid of

potash as an alterative the toughening of the aortic wall so that it may not give way.

As a matter of fact, the prognosis in very large aneurysms as to rupture is much better than in small aneurysms. If you have ever dissected an aneurysm postmortem you have had a vivid example of the thickness and toughness of the aneurysmal wall. It is, of course, not strange that such a sac does not rupture, and that it can withstand a large amount of pressure. It is not unlikely that this man who is now fifty years of age will live five or ten years more with his aneurysm. He may, of course, die much sooner, but there are cases on record of patients who have lived many years with aneurysm. It is, therefore, my custom never to give a bad prognosis to patients as regards life in cases of large aneurysmal sacs.

NOTE.—January 6, 1917. The patient has left for Florida much improved. His expectoration has entirely ceased. At his entrance it amounted to 6 to 8 ounces daily. He is much less dyspneic, and feels stronger and better.

CLINIC OF DR. FRANK WRIGHT

NORTHWESTERN UNIVERSITY MEDICAL SCHOOL

TWO-HOUR RENAL TEST

Technic and Information Obtained from the Mosenthal Modification of the Hedinger-Schlayer Test.

December 5, 1916.

A FEW days ago this man came to my office complaining of being tired and extremely irritable, with headaches about once a week. No other symptoms were noted. In the course of examination a faint albumin test was shown in the urine, hyaline and finely granular casts being present. As this was the first appearance of any finding relative to the kidney, the patient decided to enter Michael Reese Hospital for a more careful examination of kidney function.

I present him to you today that I may outline some of the tests with the results secured, but especially to emphasize the valuable information obtained by the use of the "two-hour renal test," first suggested by Hedinger and Schlayer abroad and carefully worked out by Mosenthal and others in this country.

Briefly, the patient is fifty-eight years of age, a manufacturer, who has never been seriously ill. Six years ago he had frequent painful urination, with showers of very fine uric acid calculi. Four years ago several attacks of vertigo after excessive smoking. At that time he had no albumin or casts and his systolic blood-pressure ranged between 150 and 160. He is very fond of the pleasures of the table, drinks perhaps a pint of whisky a month; indulges at intervals in wine, but only moderately, and smokes to excess.

The physical examination yields nothing of importance; the heart-tones are pure, distinct, yet not accentuated, the area of

precordial dulness is normal, the peripheral arteries are not thickened. Nothing abnormal can be found in the lungs. The liver is not palpable, all reflexes are brisk. There is no prostatic enlargement. In spite of this, the general appearance of the man is not good, he simply appears to be older and grayer than he was a year ago. He has lost 15 pounds in three years.

At the time of entrance his blood-pressure was 130 systolic, 70 diastolic, hemoglobin 85, reds 5,184,000, whites 8200, nothing unusual in the differential count. Wassermann reaction negative. Chemical examination of the blood gave these results:

Blood urea, 40 mgm. per 100 c.c.

Non-protein nitrogen, 42 mgm. per 100 c.c.

Blood-sugar, 0.12 per cent.

CO_2 combining power, according to Van Slyke, 0.56.

R. p. H. (Marriott), 7.6.

The phenolsulphonephthalein excretion in two hours was 48 per cent.

McLean index, 88.

The patient was placed upon the Hedinger-Schlayer-Mosenthal diet and the urinary specimens kept in a small "nursery" ice-box in his room, each specimen having about 20 drops of toluene added to insure preservation.

I can best give you the details of the diet by passing out some of the mimeographed slips, the originals of which I first secured from Dr. Mosenthal. In this way you readily see the principles involved:

For..... *Date*.....

All food is to be *salt-free* food from the diet kitchen.

Salt for each meal will be furnished in weighed amounts.[1]

All food or fluid not taken must be weighed or measured after meals and charted in the spaces below.

Allow no food or fluid of any kind except at mealtimes.

Note any mishaps or irregularities that occur in giving the diet or collecting the specimens.

[1] NaCl, 2.3 gm., in a capsule accompanying each meal. Any salt unused is returned to the diet kitchen, where it is weighed and the amount used is indicated on the chart.

Breakfast, 8 A. M:

- Boiled oatmeal, 100 gm.
- Sugar, 1 to 2 teaspoonfuls.
- Milk, 30 c.c.
- 2 slices bread (30 gm. each).
- Butter, 20 gm.
- Coffee, 160 c.c.
- Sugar, 1 teaspoonful } 200 c.c.
- Milk, 40 c.c.
- Milk, 200 c.c.
- Water, 200 c.c.

Dinner, 12 NOON:

- Meat-soup, 180 c.c.
- Beefsteak, 100 gm.
- Potato (baked, mashed, or boiled), 130 gm.
- Green vegetables, as desired.
- 2 slices bread (30 gm. each).
- Butter, 20 gm.
- Tea, 180 c.c.
- Sugar, 1 teaspoonful } 200 c.c.
- Milk, 20 c.c.
- Water, 250 c.c.
- Pudding (tapioca or rice), 110 gm.

Supper, 5 P. M.:

- 2 eggs, cooked in any style.
- 2 slices bread (30 gm. each).
- Butter, 20 gm.
- Tea, 180 c.c.
- Sugar, 1 teaspoonful } 200 c.c.
- Milk, 20 c.c.
- Fruit (stewed or fresh), 1 portion.
- Water, 300 c.c.

8 A. M.:

No food or fluid is to be given during the night or until 8 o'clock the next morning (after voiding), when the regular diet is resumed.

Patient is to empty bladder at 8 A. M. and at the end of each period, as indicated below. The specimens are to be collected for the following periods in properly labeled bottles:

8 A. M. to 10 A. M.; 10 A. M. to 12 NOON; 12 NOON to 2 P. M.; 2 P. M. to 4 P. M.; 4 P. M. to 6 P. M.; 6 P. M. to 8 P. M.; 8 P. M. to 8 A. M.

The dietary contains about 13 grams of nitrogen, 8.5 grams of salt, 1760 c.c. of fluid, together with purins in the meat, soup, tea,

and coffee. These last substances have diuretic properties, and it is the response to this mixed diet, as shown by the urine, that renders the test valuable.

Much latitude is allowed in the choice of foods as long as the quantities are known, the hours of serving regular, and no food or fluid taken other than at mealtime. This means that nothing is taken by mouth from the time of the evening meal until 8 o'clock the next morning.

The urine must be collected punctually every two hours.

The urine secured from this man gave the following figures:

Time of day.	Urine.		NaCl.		N.	
	C.c.	Specific gravity.	Per cent.	Grams.	Per cent.	Grams.
8–10	70	1020	1.14	0.80	0.76	0.53
10–12	130	1020	1.05	1.37	0.76	0.99
12– 2	126	1020	1.10	1.45	0.75	0.95
2– 4	144	1020	0.92	1.33	0.76	1.09
4– 6	105	1020	1.00	1.05	0.77	0.80
6– 8	81	1022	0.71	0.57	0.77	0.63
Total day	656	....	...	6.57	...	4.99
Night, 8–8	740	1014	...	4.59	...	5.48
Total, 24 hours	1396	....	...	11.16	...	10.47
Intake of fluid, NaCl and N	1810	....	...	10.50	...	11.60
Difference	+414	....	...	−0.66	...	+1.13

For convenience the results may be charted in this manner, a method which gives a most concise picture of the activities of the kidneys, and allows a comparison with tests upon other patients, as well as with charts of the same case made previously.

In this case the points of interest are:

(1) Nocturnal polyurea; the quantity not only being greater than the average 400 c.c., but larger than the day urine. Accompanying this is a lowering of the specific gravity of the night urine.

(2) Marked fixation of specific gravity, five of the six day urines having the same specific gravity—*e. g.*, 1020. The entire range of gravity amounts to but 8 points.

(3) Failure of the kidney to respond to the ingestion of food. There is a decided lack of variation in the amounts of the day urine.

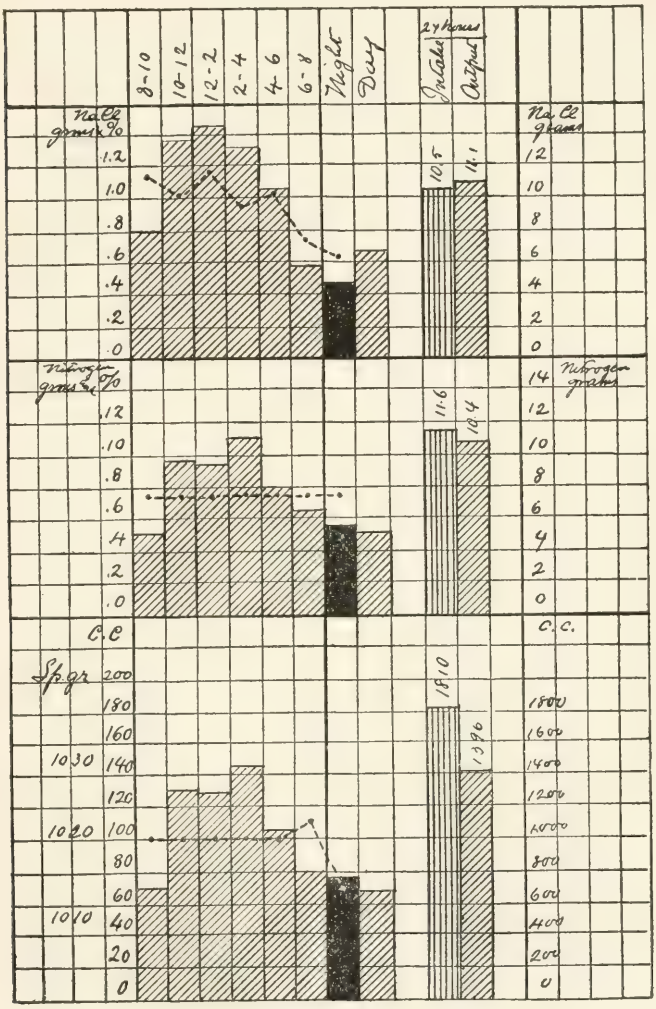


Fig. 156.

(4) Evidence of renal fatigue, the quantities of urine at 6 and 8 o'clock being smaller than those previously passed.

(5) Fixation of the percentage amounts of nitrogen, the inability of the kidney to concentrate nitrogen to the amount of 1 per cent., and the passage of a larger quantity at night than during the day.

(6) In marked contrast is the ability of the kidney in this instance to excrete salt, to concentrate it to 1 per cent. or more, and you will note that the day's excretion of salt is greater than the amount in the night urine.

For the purpose of contrast I am showing you the results obtained in a normal individual. In this case the nitrogen was estimated only in the night and day specimens. If you will contrast each point as emphasized in the case of nephritis you will find the normal differs:

Time of day.	Urine.		NaCl.		N.	
	C.c.	Specific gravity.	Per cent.	Grams.	Per cent.	Grams.
8–10	106	1015	0.52	0.56		
10–12	190	1014	0.63	1.20		
12– 2	113	1020	1.02	1.15		
2– 4	97	1026	1.03	1.00		
4– 6	73	1022	0.95	0.69		
6– 8	346	1006	0.16	0.56		
Total day	925	....	...	5.16	0.46	4.25
Night, 8–8	250	1020	0.47	1.17	1.22	3.05
Total, 24 hours	1175	....	...	6.33	...	7.30
Intake of fluid, NaCl and N	1800	....	...	9.00	...	10.50
Difference	+625	....	...	+2.67	...	+3.20

While the chemical examination of the blood in this case gave us information (the urea and non-protein nitrogen being higher than normal) and the phenolsulphonephthalein excretion being somewhat low, none of these methods have yielded the insight into the true condition of affairs as has the reaction of the kidneys while the patient is following the two-hour plan. In this instance the McLean index is of no help.

You may say that the method involves too much laboratory work. In that case, estimate the chlorids, and instead of using

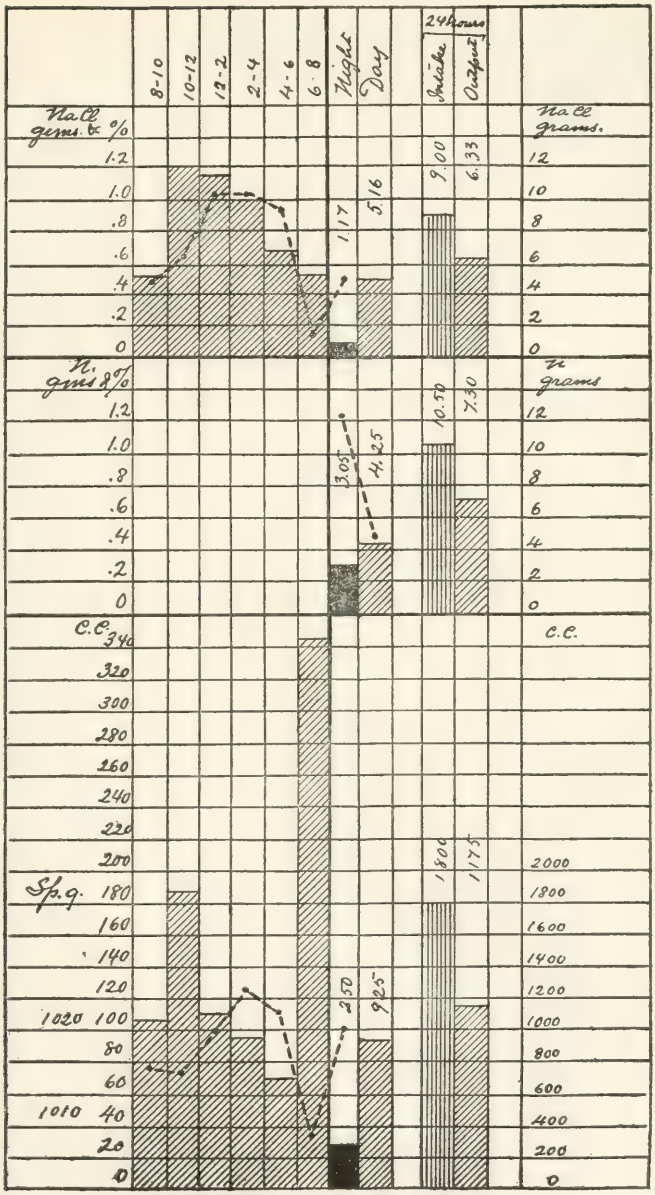

8-10
10-12
12-2
2-4
4-6
6-8
Nights
Day
24 hours
Intake
Output
NaCl gms. & %
1.2
1.0
.8
.6
.4
.2
0
9.00
6.33
1.17
5.16
NaCl grams.
12
10
8
6
4
2
0
N. gms & %
10.50
7.30
3.05
4.25
N grams
C.C.
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
1800
1175
2.50
925
Sp.g.
1020
1010
2000
1800
1600
1400
1200
1000
800
600
400
200

Fig. 157.

Kjeldahl's method on the urine, titrate the urea instead, using the urease method.

If that be more work than you feel like doing, you will find that simply watching the amount and specific gravity of night urine and the variations in the quantities and specific gravity of the day urine will give you a wealth of information.

CLINIC OF DR. FRANK SMITHIES

AUGUSTANA HOSPITAL

RETROPERITONEAL SARCOMA

Rapidly Developing Abdominal Tumors and Ascites in Young Adult Male. Differential Diagnosis: Significance of Clinically Observed Facts and Laboratory Tests. "Blumer's Rectal Shelf."

Abdominal Paracentesis: Study of Ascitic Fluids.

Treatment of Case: Röntgen Therapy; Coley's Serum; Diet; Medicinal.

Autopsy (November 10, 1916): Retroperitoneal Sarcoma; Fatty Cirrhosis of Liver; Interstitial Nephritis; Splenic Enlargement (Passive Congestion).

October 20, 1916.

EVEN a superficial glance at the young man before you suggests that there exists an ascites—an abnormal accumulation of fluid in his peritoneal cavity. The fixed, symmetrically bulging, barrel-shaped belly, with its protruding navel and covered by cyanotic, shiny, cracked skin, not only instantaneously convey the impression of ascites, but, as he lies here, the patient's pale, sweat-beaded forehead, anxious expression, dyspnea, and restlessness indicate that the peritoneal sac is so distended that unless relief is soon given a fatal circulatory crisis will be reached. Hence, the immediate indication in this case is not "watchful waiting" while the finer points of diagnosis are being quibbled over, but *paracentesis abdominis* quickly performed.

DR. SMITHIES (to Assistant): Please have the patient given morphin sulphate $\frac{1}{4}$ grain, and adrenalin chlorid 10 drops (1 : 1000 solution) hypodermically, and have the nurse prepare the instruments.

VISITING PHYSICIAN: Doctor, why do you give the adrenalin solution?

DR. SMITHIES: It aids in preventing shock following paracentesis by contracting the peripheral vessels and maintaining blood-pressure, particularly in the vessels of the splanchnic area.

While arrangements for paracentesis are being made, permit me to briefly review the patient's history and emphasize certain physical and laboratory findings:

This young man is a Scandinavian tailor, aged thirty-one. He entered the hospital four days ago on account of weakness, obstinate constipation, abdominal discomfort, with "swelling," belching, and "nervousness."

His *early history* exhibits nothing unusual, with the exception of rather obstinate diarrhea at about the age of seventeen (alcoholism?). The *past history* details nothing striking until about two months ago. Venereal disease is denied. Here and there is a tattoo-mark on the left forearm. Ardent worship at the neighboring shrines of Bacchus and Venus is admitted. Without any change in his mode of life or in association with any acute illness or injury, eight weeks ago he suddenly experienced *severe epigastric pains*, shortly followed by *vomiting* of the food recently eaten, and later by a prostrating *diarrhea*. Epigastric soreness, nausea, with occasional vomiting, and the watery frequent bowel movements continued for about a week. He then became obstinately constipated. Pus, blood, mucus, parasites, or abnormal coloration of the stools were never noted. There have been no chills, fever, sweats, or jaundice, no dysuria, and no further attacks of colicky pains. *Appetite* has been ravenous and there has never been dysphagia. *Ascites* appeared about a fortnight since, and has progressed so rapidly that five days ago the patient's home physician drew off about a gallon of greenish-brown fluid, rich in albumin. *Weight* has been constant within the past month, although weakness and loss of flesh are evident (compensatory weight gain due to accumulation of peritoneal exudate?).

Physical examination discloses an anxious-looking, dyspneic, loquacious, undernourished male, with cyanotic toes, finger-tips,

ears and chin, and soft edema about the ankles and over the shins.

The *eyes* have yellow-tinged sclera, equal, active pupils, and *ophthalmoscopically* are seen pale, edematous *fundi oculorum* with engorged veins, but no hemorrhages.

The *mouth* is dry, the teeth are very poor and the tongue swollen, marked by the teeth, and covered with thick, tenacious slime.

The *neck veins* are engorged, particularly on the right.

The *thorax* flares below, moves *en cuirasse*. *Lung percussion* demonstrates hyperresonance above the nipples, but diminished resonance in both lower axillæ, without shifting dulness. On auscultation, harsh, compensatory, vesicular breath sounds are heard above the fourth rib on the right, but quiet, distant vesicular with occasional moist râles are noted in the axillæ. There is no egophony in either axilla and thus apparently no free fluid. Respiration rate is 30. The *heart* is displaced upward and to the right, the apex-beat being on a level with and just inside the nipple. The heart sounds are weak but pure; the rate is 100; there is no arhythmia. *Systolic blood-pressure* is 115; diastolic 80 (by auscultation).

The *abdomen* is somewhat flat ventrally as the patient lies on the cart, but is well rounded laterally. The navel protrudes and the superficial veins are distended in the flanks; dilatation and engorgement of the veins radiating from the umbilicus (*caput medusæ*) is not noted. Gentle tapping easily demonstrates *fluctuation waves*. *Palpation discloses several tumor masses.* There is a firm, fixed, nodular mass, only slightly tender, above and to the right of the navel. It is as hard as cartilage. There are several smaller, slightly movable nodules scattered about below the larger mass (Figs. 158 and 159). The liver descends two fingerbreadths below the rib edge in the right nipple line. The spleen is not felt, but on percussion its upper border appears to reach the sixth rib in the left axillary line, pointing perhaps to displacement upward or probable enlargement ("stasis spleen"?). The left inguinal nodes are the size of kidney beans, discrete, and are not tender. *Percussion demonstrates movable dulness* in the

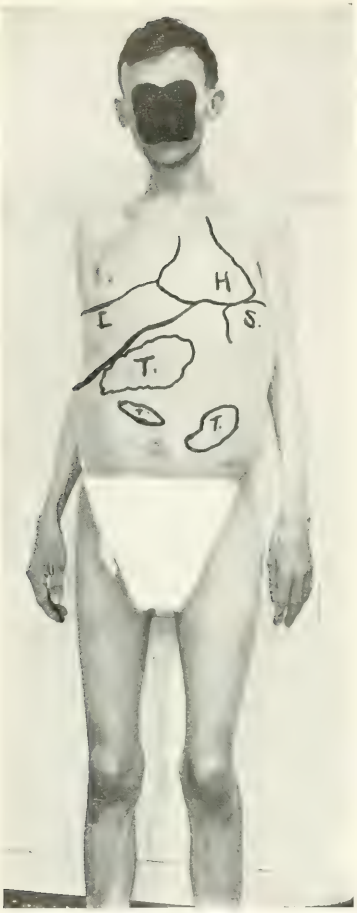


Fig. 158.—Photograph of patient with ascites due to retroperitoneal sarcoma (front view): *H*, Heart displaced upward; *L*, enlarged liver; *S*, enlarged spleen; *T*, *T*, *T*, nodular abdominal masses palpable through ascitic fluid. Note general cachexia, bulging lateral walls of abdomen, and protrusion of navel. (Leo Blum, photographer.)

Fig. 159.—Side view of patient shown in Fig. 158: *H*, Heart; *S*, spleen; *L*, liver; *T*, *T*, tumors. In addition to cachexia note barrel-shaped bulging belly and cyanosis over lower abdominal wall, face, hands, and legs —patient had been standing about twenty minutes. (Leo Blum, photographer.)

flanks and tympany in the umbilical zone (gas-distended bowel, floated upward).

Rectal examination reveals that the rectovesical space is filled with firm, discrete, and confluent nodules. The *genitalia* are normal.

Laboratory Findings.—*Test-meal* (after full diet): No retention after an eight-hour interval. *Secretory meal:* Free HCl, 0; total acidity, 20; gastric extracts negative for blood, lactic acid, bile-pigment, or bacilli of the Oppler-Boas group.

Stool (following catharsis by Carlsbad salts): Alkaline, thin, light-yellow purée of somewhat musty odor. It contains undigested cellular waste and an excess of mucus. *Chemically blood is absent* (benzidin test), *hydrobilirubin* present (Schmidt bichlorid test), and *trypsin* absent (Gross-Fuld-Wohlgemuth method). *Microscopically* there is nothing unusual apart from undigested muscle bundles and few plant cells (patient on Schmidt test-diet for thirty-six hours).

Urine.—Red-brown color; specific gravity, 1025; twenty-four-hour quantity, 250 c.c.; acid reaction, albumin in slight trace. *Microscopically* there is an excess of calcium oxalate crystals, amorphous urates, red blood-cells, leukocytes, and squamous and bladder epithelium (congestion; chronic cystitis).

Blood Examination.—Hemoglobin, 80 per cent.; R. B. C., 4,700,000; W. B. C., 8200. Differential reveals nothing abnormal. *Wassermann test*, 1—.

Tuberculin Tests.—Von Pirquet negative; no local or constitutional reaction to 5 mg. old tuberculin injected subcutaneously.

Röntgen Examination (Thorax).—Lungs: Clouded axillary areas; mediastinum clear; diaphragm highly arched on the right, contour normal. *Heart* dilated on both sides and displaced up and to the right.

Esophagus.—Normal.

Stomach (Fluoroscopic).—Rather bottle shaped and lies altogether above the navel; it is pushed to the left in its pyloric fourth; contour is regular *except toward the pylorus*, where there is slight irregularity and stiffening of the wall; peristalsis moderately vigorous; pylorus wide opening and stomach empties rapidly. The antrum is fixed posteriorly; the duodenum is fixed and stiff; the opaque meal appears to "drop" through it into the jejunum.

The edge of the liver can be made out. It overlaps the pyloric third of the stomach; it is thin, sharp, and regular. The ab-

Fig. 160.—Röntgenogram of stomach of patient shown in Figs. 158 and 159. Arrows point to deformed antrum and pylorus. This region was stiff and thick and fixed posteriorly to the pancreas by extension of the sarcomatous growth. Observe gaping pylorus (*P*) with rapid emptying of the stomach so that duodenum (*D*) and jejunum (*J*) are almost instantly visualized. (Augustana Hospital Plate, Leo Blum, Technician.)

dominal masses noted in Figs. 158 and 159 are seemingly primarily extragastric and the largest lies somewhat below the stomach.

Plate (made with difficulty on account of the ascites) confirms fluoroscopy (Fig. 160).

Colon.—Empty in thirty-eight hours, with no local lagging or retention.

Hospital Course.—Except for respiratory and circulatory embarrassment, the patient has been quite comfortable during his hospital residence (four days). Pulse has ranged from 90 to 126, respirations from 20 to 42. Temperature has never reached 100° F., even when old tuberculin (5 mg.) was given. Appetite has been excellent, but capricious; sleep sound. Of late the patient has been drowsy during the day. He has also become very loquacious and talks frequently in a rambling fashion.

Recapitulation.—*A middle-aged male, of irregular habits, but in good health for the past twenty years, suddenly experiences severe abdominal pain, diarrhea, and vomiting. Ascites rapidly supervenes, and he seeks a physician, who withdraws a large quantity of greenish-brown fluid and is then able to delimit multiple abdominal nodules. Constipation, re-accumulation of peritoneal fluid, emaciation, and circulatory embarrassment quickly render the patient helpless.*

Our clinical examinations demonstrate marked abdominal distention associated with ascites and multiple tumors; nodules in the rectovesical space ("Blumer's shelf"); impaired circulation (cyanosis, edema—peripheral and fundus oculi—displaced heart, waterlogged lung bases); enlarged liver; diminished urine output with slight albuminuria and hematuria; infrequent stools of diarrheic type, evidencing undigested food and absent tryptic ferment, but blood free; gastric achlorhydria without stagnation; mild secondary anemia with faintly positive Wassermann reaction; negative tuberculin tests and (röntgenoscopically) displaced heart, fixed antrum of the stomach, gaping pylorus, rapid gastric emptying, and abdominal tumors seemingly extragastric.

The large bowel exhibits neither stasis nor deformity.

Discussion of Diagnostic Possibilities.—*The most pronounced feature of this case is the rapidly developing abnormal increase in the amount of peritoneal fluid.* Ascites is always a sign of disease and is not of itself primarily an ailment. There is no disease

named "dropsy." When this sign presents, it is up to the physician to determine what produces it. This is essential in order to determine the point of attack therapeutically. Less frequently than "once in a blue moon" does the mere relief of an ascites by paracentesis alone prevent re-accumulation of fluid and bring about permanent cure.

The **causes of ascites** are numerous, but, as Cabot has shown in the analysis of 2217 autopsies, in 88 per cent. of instances where ascites was demonstrated postmortem the causes were:

(1) Cardiac weakness.
(2) Neoplastic peritonitis.
(3) Renal disease.
(4) Cirrhosis of the liver.
(5) Peritoneal tuberculosis.

In the remaining 12 per cent. of cases there were found in the order of their frequency: adherent pericardium, eclampsia, thrombosis (caval, mesenteric, or portal), chronic fibrous peritonitis, uterine fibromyoma, intestinal obstruction, pancreatitis, ovarian cyst, acute yellow atrophy of the liver, and "status lymphaticus."

Clinically, to this group should be added cancer of the intestines, malignant disease of the liver, blood dyscrasias (pernicious anemia, leukemia), abdominal lymphoma (lymphosarcoma, lymphoblastoma), and visceral syphilis. There are frequently given, clinically, numerous other causes for ascites. Many such are extremely fantastic: clinical opinions unsupported by pathologic study or postmortem examination are often incomplete or wide of the mark altogether.

Applying Cabot's autopsy classification of causes to the ascites in the patient before you, can we exclude an ascites due only to (1) *cardiac weakness?* It would appear so. While it is true that this patient is dyspneic, somewhat cyanotic, exhibits slight peripheral edema and frequent, fluctuating pulse, he has a blood-pressure of 115 systolic and 80 diastolic, clear, pure heart sounds, and no enlargement of the heart or evidences of incompensation. His past history is negative with respect to heart disease, and it is to be observed that *until ascites appeared there was neither cardiac nor respiratory embarrassment.* In the great majority of instances of

ascites consequent upon cardiac failure there is demonstrable valve leakage (mitral and tricuspid, aortic), or stenosis (mitral and aortic, aortic), or pericardial disease. By physical and röntgenologic examination such are proved to be absent in our patient.

With your permission I will postpone the probabilities of a neoplastic peritonitis until later.

(3) *Renal disease* is evidenced in this patient by a trace of albumin in the urine, numerous red blood-cells, and diminished twenty-four-hour urine output. *In none of the urine samples, however, have casts been demonstrated*, even though the specific gravity is rather high (1025). In an ascites of renal origin there should be either more marked albuminuria and casts, if the twenty-four-hour quantity is so reduced as in this case (parenchymatous nephritis), or there should be little or no albumin with few casts, increased twenty-four-hour output and low specific gravity (interstitial nephritis: "contracted kidney"). The time element would be different from this case. Unless the renal upset occurred in connection with an acute ailment which, as we have shown, is absent in this case, there would commonly be found a chronic history of renal disturbance. The patient unless definitely luetic would probably be older than thirty-seven. Secondary changes in the heart and blood-vessels, with probably higher systolic pressure than this case exhibits, or with smaller pulse-pressure, changes in the *fundus oculi*, and the history of peripheral edema or obstinate "bronchitis" before ascites developed would ordinarily be demonstrable. It would appear to me that whatever abnormalities are shown by the heart and kidneys of this patient are secondary to other more essential causes.

(4) *Cirrhosis of the liver* is very difficult to exclude in this case, at least as a contributory cause of the ascites. The patient was a heavy drinker as a young man, and even now, like many tailors, indulges rather freely in alcoholics at times. Moreover, there is a hint at lues in the faintly positive Wassermann reaction and the patient's admission of his frequent opportunities to acquire venereal disease. Examination reveals a large liver, but its edge is thin and both edge and surface are smooth and regular. These

should, however, be again examined after paracentesis in order to avoid error.

Other tumors in this case than that of the large liver are, moreover, readily palpable in the abdomen and rectum. These could not be due to liver disease alone. They might be consequent upon it, however, and represent thromboses of mesentery or omentum or a terminal tuberculosis of the peritoneum.

The spleen appears enlarged as in certain forms of cirrhosis. The youth of the patient, the brief history of the ailment, the onset with severe pain, vomiting, and diarrhea, and the rapid accumulation of peritoneal fluid, without jaundice, and fever render the possibility of the ailment's being primarily cirrhosis but vague. A moderate fatty enlargement of the liver is, however, probable.

(5) *Peritoneal tuberculosis* warrants careful exclusion on account of the youth of the patient. No primary focus can, however, be shown in the mediastinum or lungs, nor is there history of an earlier ailment that might have been tuberculous. Moreover, the patient has been practically afebrile—a rare accompaniment of tuberculosis of the peritoneum. Tuberculin tests have been uniformly negative, but, of course, in a late stage of tuberculosis negative reactions are by no means rare. The possibility of a poor tuberculin preparation must likewise be considered. Chills and sweats have been absent. Strength and appetite have remained good. The acute onset of the disease and its rapid progress with practically all manifestations being confined to the belly are also against the ailment's being tuberculous in nature. The ascitic fluid removed before the patient entered the hospital is described by his physician as being thick and dark colored and rich in albumin. This does not resemble the fluid commonly found with tuberculous peritonitis.

The history of the case and our examinations already outlined exclude adherent pericardium thrombosis, yellow atrophy of the liver, malignant disease of the liver, blood dyscrasias, and "status lymphaticus" as likely causes for ascites in this patient.

Clinical examinations reveal a pancreatic insufficiency associated with early diarrhea and pain. It is not unlikely that

the pancreas is definitely involved, but where the condition is one of neoplastic disease primary in the pancreas we should expect jaundice due to common duct obstruction, rapid and persistent emaciation, probably pyloric stenosis and ascites developing late, and not early in the course of the disease. In malignant disease of the pancreas there are rarely multiple abdominal tumors, and metastases to the rectovesical pouch are not found.

Fibrous peritonitis in association with syphilis can only be excluded on the absence of a history of syphilis, only a slight suggestion of positive Wassermann test, acuteness of onset, and the presence of nodules palpable per rectum.

Intestinal obstruction may have been secondarily brought about in this case. The acute onset with pain and vomiting suggests an obstructive attack, but it is quite unusual to have obstruction of the bowel continue for two months without its presenting more marked clinical and röntgenologic evidence than we have found in this patient. It will be recalled that the stools have been constantly blood free. More than 70 per cent. of malignant tumors of the bowel are associated with gross, microscopic, or chemically demonstrated blood in the stools. Of course, the duration of the ailment is against the possibility of an acute obstruction. Death from perforation or inanition would have long since taken place.

In order to better study the nature of this abdominal tumor we will now draw off some of the peritoneal fluid.

Paracentesis Abdominis.—As you can see, the patient is more comfortable since his hypodermic injection of morphin and adrenalin. We will have him sit up on the cart, with his legs over the side, and have him supported by the nurse, who will keep a sterile sheet bound tightly around the upper abdomen. By traction on this sheet intra-abdominal pressure can be maintained as the ascitic fluid is withdrawn. Collapse from dilatation of vessels in the splanchnic area can thereby in a measure be prevented. The patient's urinary bladder is now catheterized. It is absolutely necessary to do this in order to avoid injury to a distended bladder or to prevent bladder puncture with the withdrawal of urine which may be mistaken for ascitic fluid. The

infranavel region is painted with iodin solution. Next I will infiltrate the region midway between the pubis and navel with 2 per cent. novocain solution. This is the point of election for paracentesis abdominis because here during the puncture one avoids large vessels, and after the trocar enters the peritoneal sac, injury to the bowels is reduced to a minimum because the gas-distended intestines float up into the supernavel region in or on top of the ascitic fluid. Puncture of the bowel or injury to it may, however, result if masses of adhesions hold the bowels down toward the pelvis. There is now, as you see, complete anesthesia of the skin, but before puncturing I will inject some of the novocain solution deeply into the abdominal wall. In this way the paracentesis will be practically painless. A skin incision is next made with the scalpel. It should be long enough to enable free separation of the fat by a blunt dissection down to the fascia overlying the abdominal muscles. Some of the novocain solution escapes, as you can see, but the shiny fascia is now in view and the trocar may be inserted. I prefer a trocar of this type (exhibits trocar). It has, as you see, several lateral openings as well as the opening at the end. These lateral openings will insure free drainage of fluid even should a portion of the abdominal tumor occlude the distal end of the trocar. I now insert the trocar boldly but carefully, noting when the muscular wall has been punctured. Just so soon as the free end is in the peritoneal sac you will observe that I remove the obturator before advancing the trocar any further. In this way I avoid injury to any intra-abdominal part. As you see, ascitic fluid is already coming out under considerable pressure. To the side arm of the trocar we attach this sterile rubber tube, collect 250 c.c. of the fluid in a sterile glass for examination, and allow the remainder of the fluid to syphon off into the bucket. It is well to not allow the fluid to flow out continuously, but to stop the flow every minute or two in order that intra-abdominal pressure and intra-abdominal circulation may become readjusted.

The Ascitic Fluid.—As you see, the fluid in this case is yellowish brown, turbid, and foams abundantly on dropping into the pail. It has a sticky feel and a somewhat fleshy odor. These

facts indicate that the fluid is most probably not a simple transudate, but that it is of rather high specific gravity and rich in albumin. The fluid does not resemble that of an accumulation of heart or renal disease. Ascites in those ailments, unless there have been thromboses or emboli, is commonly light in color, clear, not sticky to the feel, does not foam freely, and has relatively low specific gravity. Neither does this ascitic fluid resemble that associated with tuberculosis. Tuberculous ascitic fluid is commonly straw colored and usually clear. There are instances, however, where tuberculous processes in the peritoneum are dark colored (bloody), turbid, and of moderately high specific gravity. This fluid would not appear to indicate that there had been obstruction of the larger lymphatic ducts (encroachment upon the thoracic duct or *receptaculum chyli*). In such event the ascitic fluid would probably be milky or translucent. Grossly, this peritoneal fluid might be associated with a cirrhosis. It is not uncommon for ascites in cirrhosis of the liver to be of dark color as a consequence of admixture with bile or blood. However, in view of the multiple abdominal nodules, it would seem that this ascites comes from a case of malignancy.

As the peritoneal sac is being emptied you may observe that fluid comes away in irregular spirts. This is due to small firm masses coming in contact with the end of the trocar. They can be distinctly felt striking against its distal end. While the specimen of ascitic fluid is being analyzed we will now examine the abdomen. (Trocar withdrawn, patient permitted to lie down; abdominal wound sutured with through-and-through silk ligatures and covered by two large absorbent gauze pads.)

The Abdominal Tumor.—It is now possible to observe that removal of the pailful of ascitic fluid allows better examination of the tumor mass. Inspection permits the recognition of three masses in addition to the diffuse bulging in the right upper quadrant (liver?). The upper of these masses appears as large as a duck egg and it moves somewhat with respiration. The lower masses are fixed and somewhat smaller than a chicken's egg. Palpation proves the abdominal wall to be free from tumors and enables one to feel the edge of the liver descending almost to the navel.

The edge is thin and smooth and the liver surface is also smooth. The spleen can be but indefinitely felt. The upper of the three abdominal nodules is almost as hard as cartilage, is not tender, and made up of numerous rough, smaller masses. It can be displaced downward to the right below the level of the navel. The lower masses are deeply fixed and of the same general character as the upper, except that they are not so firm.

Localization of abdominal tumors is not infrequently difficult. Study of more than 1400 abdominal tumors demonstrated to me that slightly above 90 per cent. of all tumors lying above the navel were either primarily or secondarily connected with the stomach. In 87 per cent. of instances they were malignant. Other tumors lying in the epigastrium were enlargements of the liver (benign or malignant), tumors of the pancreas (cyst or neoplasm), tumors of the omentum, bowel or kidney, or tumors connected with the spleen, retroperitoneal sarcoma, subdiaphragmatic abscess, or aneurysm of the abdominal aorta. The clinical and röntgenologic study in this case have apparently shown us that the main tumor mass is extragastric, although the fluoroscopic examination seems to indicate that there has been invasion of the pyloric fourth of the stomach with posterior fixation of that viscus. Liver, kidneys, spleen, and abdominal arteries seem to be negative with respect to the tumor. The history and stool examination would indicate that the pancreas has not remained free from invasion. Paracentesis abdominis, which has just been performed, apparently indicates by the manner in which nodules impinge against the distal end of the trocar that peritoneum and probably omentum had not remained free.

In the male, tumors lying below the level of the navel are commonly malignant involvement of the lymphatics, neoplasms of the bowel and of the bladder, abscesses, aneurysms, and occasionally new growths arising from the pelvis. In this patient it is possible to exclude everything except tumors arising from lymph-tissues.

Laboratory Report of Ascitic Fluid.—The specific gravity is 1034 and the fluid contains one-fourth volume albumin. This at once indicates a definite peritonitis. Benzidin test for blood

is positive. Such reaction might, of course, come from blood passing into the ascitic fluid as result of injury by the trocar to the abdominal wall or to the intraperitoneal structures. Test for bile (Gmelin test) is negative, microscopic examination shows great numbers of endothelial-like cells with large pale staining nuclei, but in none of the nuclei are seen mitotic figures. The cell count shows few red blood-cells and numerous lymphocytes. In spite of the fact that there are many lymphocytes in this ascitic fluid, the presence of many endothelial cells, blood, much albumin, and high specific gravity would indicate to me that we are dealing with malignancy and not with tuberculosis. In some of the most marked instances of tuberculous peritonitis the ascitic fluid will contain less than 25 per cent. of small lymphocytes. Of course, some of this ascitic fluid must be injected into a guinea-pig in order to further exclude tuberculosis or low-grade sepsis. Tubercle bacilli are rarely found in the peritoneal exudates.

(5) *Neoplastic Peritonitis.*—In males such cases are usually secondary to lymphosarcomata or lymphoblastomata, having their origin in the adenoid tissue along the spine. Commonly, when there are evidences of the peritoneum and omentum being extensively involved, the retroperitoneal lymph-tissue along the spine is the seat of a great tumor, and secondary extensions can be demonstrated in some of the abdominal viscera. The patient before you appears to be affected with this type of tumor, and direct extension has most likely taken place in the pancreas and (as shown by the *x*-ray examination) to the pyloric fourth of the stomach. The recent constipation may be an evidence of systemic weakness, interference with circulation, direct extension to the walls of the bowel, or pressure upon the bowel from peritoneal masses.

DIFFERENTIAL DIAGNOSIS OF COMMON AILMENTS ASSOCIATED WITH ASCITES

(Adapted from Smithies and Ochsner's "Cancer of the Stomach")

Signs and symptoms.	Nature of the disease.				
	Gastric cancer —peritoneal or hepatic metastases.	Cancer of peritoneum.	Tuberculous peritonitis.	Cirrhosis of liver.	Cardiorenal disease.
Age.	Forty-five.	?	Young adults.	Forty.	Forty.
Sex.	Males.	Females.	?	Males.	Males ?.
Onset.	Previous peptic ulcers or primary malignant gastric disease.	Secondary to pelvic or gradual and atypic.	Pulmonary or abdominal tuberculosis (kidneys, ovaries).	Gastritis; alcoholic excesses.	Infectious exposure or cardiorenal overstrain.
Pain.	Present in 95 per cent.	Colics may occur early or late.	Colics or ache early.	Distress late.	Irregular cramps at times.
Vomiting.	Common early or late.	Infrequent.	Not the rule.	Variable.	Irregular.
Weight loss.	Progressive.	Progressive.	Progressive, but often very gradual.	Marked in late stages.	Variable.
Cachexia.	Pronounced.	Pronounced.	Pronounced late.	Sometimes late.	Infrequent.
Appetite.	Poor.	Poor.	Capricious.	Variable.	Often good.
Bowels.	Constipation often.	Variable.	Diarrhea variable.	Constipation; diarrhea at times.	Diarrhea and constipation alternating not infrequently.
Blood-pressure.	Reduced.	Reduced.	Reduced.	May be increased.	Usually increased.
Jaundice.	Late if at all.	Rare.	Rare.	May occur.	Infrequent.
Abdomen.	Often scaphoid, but may be distended in flanks or wholly.	Distended late.	May be early, tense or distended.	Tense or distended.	Distended.
Tumor.	In 3 out of 4 cases.	Early multiple nodules.	Numerous ridges often above navel; slow development.	Local enlargement in right upper abdomen (liver).	Liver may enlarge or no tumor present.
Fluid.	Usually free; serous or bloody "cancer cells" (?).	Often in loculi; bloody, chylous, or serous "cancer cells" (?).	Serous or cloudy, many small lymphocytes; bacilli rarely found.	Serous, rarely bloody, but may be bile-stained.	Serous.
Test-meal.	Low or absent HCl; twelve-hour retention lactic acid; altered blood or Oppler-Boas bacilli.	Low HCl.	Often low HCl.	HCl may be normal.	HCl may be normal.
Stool.	Altered blood in 89 per cent.	Blood rare.	Blood late.	Blood may occur late.	Blood infrequent
Urine.	May be normal.	May be normal.	Albumin late.	Albumin late.	Large volumes of albumin and casts often early. Phenolsulphonephthalein test.
Radiogram.	Gastric retention variable; filling defects.	Usually negative.	Usually negative.	Negative or pressure defect from liver.	Usually negative.
Metastases.	Common.	Common to serous surfaces or belly wall.	Involvement of lungs, liver, intestines, or pelvic organs.	Absent.	Absent.
Edema.	Late and limited.	Late and limited.	Late and limited.	Late and not often marked.	May be marked early.
Temperature.	Infrequent increase.	Infrequent increase.	Irregular elevation.	Elevation late.	May be subnormal.

The diagnosis of neoplastic peritonitis in association with peritoneal sarcoma is in this case based upon the youth of the patient, his previous good health, the rapid onset with emaciation and ascites, the proof of extragastric tumors, the presence of nodules in the rectovesical space (Blumer's shelf), the character of the ascitic fluid, negative tuberculin tests with absence of local tuberculous foci, and the apparent proof of no primary cardiac-renal or liver fault.

Prognosis.—This is grave on account of the extent of the abdominal masses, rapidly accumulating ascites, and the severe secondary changes in the heart, kidneys, liver, stomach, and pancreas. Such patients as this cannot be expected to live longer than a few months. Operative relief is not possible on account both of the histologic character and the extent of the neoplasm. Palliative therapeusis only is possible.

Treatment.—Operative interference in this case is contra-indicated. I would lay particular emphasis upon very patent clinical findings which contra-indicate surgery. Of these, the most important evidence, apart from the ascites itself, is the presence of multiple nodules palpable per rectum. This collection of nodules in the rectovesical space forms roughly a sort of shelf-like tumor. The nodules lie behind the bladder above the prostate and anterior to and not connected with the rectum. They indicate lymph-node metastases. Collections of glands in this location have been fully described by various authors, but particularly by Blumer. As a consequence of his thorough description of the clinical significance of glands lying in this position in instances of abdominal tumor, the name "Blumer's shelf" has been applied to this clinical sign. When such glands are present, operative interference can only be palliative; the malignant cells have become scattered through the lymph-stream far away from the primary focus, and even if it were possible to remove that focus, the progress of the disease would not be halted. Another sign of inoperability is, of course, the ascites. Where an abdominal tumor exists, particularly if such tumor be located in the epigastrium, the development of ascites indicates a hopeless condition with respect to operative cure.

Other lymph-gland signs of inoperability of abdominal tumors might be mentioned. They are evidences of metastases as indicated by enlargement of the lymph-nodes just above the left clavicle ("Virchow's node"); palpable nodules in the liver; fixation of the navel with umbilical tumor formation; enlargement of the inguinal lymph-nodes; the Röntgen demonstration of mediastinal infiltration—the last sign is not infrequently obtained with difficulty.

If rectal examinations were more uniformly made in instances of abdominal tumor, much needless surgery might be avoided. Certainly surgical procedure would often be entered into with a more limited prognosis than is now frequently given. If the rectal examinations fail to disclose glands in the rectovesical space, then search for metastases as indicated in the above paragraph should not be neglected.

In females one must be careful not to mistake small collections of fibroid nodules in a misplaced uterus for rectovesical metastasis. Occasionally a tumor of the bladder confuses, and if the patient has been poorly prepared for examination, collections of hard fecal material may closely simulate Blumer's shelf. Growths in the lower bowel itself are usually excluded readily, inasmuch as the symptomatology differs from that in which there is a primary abdominal tumor. Moreover, the proctoscopic examination commonly reveals the location of the sigmoid or rectal growth. Of course, it should be understood that the glands forming Blumer's shelf are not seen proctoscopically, inasmuch as they lie outside the bowel in the rectovesical space.

An attempt should be made to prevent the reaccumulation of the ascitic fluid. The patient will be given 15 grains of diuretin every two hours and frequently brisk purges with calomel and magnesium sulphate. His diet will be salt free and as dry as possible. The cardiac weakness can possibly be taken care of by digitalis either in the form of a good tincture or freshly made infusion. The patient will be kept in bed in order to mechanically reduce venous congestion. Distention of the bowels will be relieved by morning turpentine and soapsuds enemata. If the patient is not too weak, once daily a general hot-

air bath will be given. Antiluetic medication will be pushed partly on account of the past history of the case and the faintly positive Wassermann reaction, but mainly because it seems to be a fact that certain forms of sarcoma have their growth retarded by means of mercury and iodid. In spite of all these measures, frequent paracentesis abdominis will have to be performed. Fluid accumulates very rapidly in these cases. It is not uncommon for the rate of accumulation to be as rapid as several quarts daily.

Actinotherapy offers some possibilities of good when these patients can be caught early in their disease. It is doubtful if there will be much improvement in this case, but daily *x*-ray treatments with the Coolidge tube will be given. The abdomen should be carefully mapped out in areas and each area successively treated daily. From four to eight erythema doses with the tube at about 8 inches distance should be given over each area at a *séance*. The portion of the abdomen not being treated should be carefully protected with lead-impregnated rubber. Care should be taken that no oils or ointments should be used over the area being treated. If such are used, severe *x*-ray burns are very likely to follow. If *x*-ray burns occur they are taken care of either by *scharlach rot* ointment or by the application of 25 per cent. solution of argyrol. At the first evidence of *x*-ray burn, of course, the treatments should be stopped.

Coley's serum should be tried in cases of this type. It is advisable to begin with a dose of $\frac{1}{2}$ to 1 drop of the serum every second or third day. If there is no constitutional reaction, the dose may be increased. Some patients are able to take as high as 12 to 20 drops of Coley's serum every third day without serious consequences, and it would seem with decidedly beneficial effect upon the tumors. Personally, I have never seen an instance of true sarcoma that was permanently cured by either Röntgen therapy or Coley's serum.

Note on November 10, 1916.—Some of you will recall the case which was presented in clinic on October 20th last—the young adult male with ascites, whom we diagnosed as an instance of retroperitoneal sarcoma with involvement of the peritoneum.

The patient died early this morning. His course since he was presented to the clinic has proved interesting. Röntgenotherapy was apparently of service in softening up and making smaller the abdominal tumors which were palpable in spite of the peritoneal exudate, but there was no effect whatever upon the accumulation of the ascitic fluid or the patient's general welfare. It was necessary to tap the peritoneal sac every fourth day. At each tapping from 6 to 12 quarts of turbid, dark-stained fluid, rich in albumin and cellular elements, were removed. The patient gradually became weaker, circulatory disturbances more marked, and on account of restlessness it was necessary to administer rather large doses of opiate. He died from cardiac dilatation.

The *autopsy* demonstrated a large tough sarcomatous growth extending along the spine from the sacrum up as high as the pancreas. The omentum and peritoneum were extensively invaded. The pancreas was involved for at least four-fifths of its structure, and from the pancreas direct extension had taken place to the pyloric half of the stomach. There were numerous nodules in the mediastinum. The liver was enlarged, congested, and had a distinct fatty shine on sectioning. The spleen showed chronic passive congestion; the heart was dilated, but otherwise normal.

Frozen section of the retroperitoneal growth discloses a small round-celled sarcoma.

CLINIC OF DR. B. C. CORBUS

CENTRAL FREE DISPENSARY, RUSH MEDICAL COLLEGE

THE TREATMENT OF SPECIFIC (GONORRHEAL) URETHRITIS, ANTERIOR AND POSTERIOR

Cultural and Tinctorial Methods of Identifying the Gonococcus. Pathology of Uncomplicated Anterior and Posterior Urethritis. Management in Detail.

SIMPLE specific urethritis, which affects only the anterior urethra, and which may be cured in ten days to two weeks in private practice, and in from three weeks to one month in dispensary practice, is the form found in about one-tenth of the patients infected with the specific organism of gonorrhea. While the gonococcus infects only the anterior urethra at the onset, it invades the posterior urethra and prostate at an early date, generally before the patient seeks relief. Bad treatment or neglect may permit of earlier invasion of the deep urethra, but this complication may occur in spite of the best treatment. On the other hand, infection of the posterior urethra and prostate in many cases is a bacterial progression which can be controlled if the patient is seen early and the case properly managed. The possibility of standing 5 or 10 feet away from a patient with urethral infection, looking at his tongue, and prescribing for a urethral discharge is hardly conceivable, yet it occurs all too frequently. If all cases of specific urethritis could be confined to the anterior urethra, the infection would amount to little, but once an infection has passed into the posterior urethra the case becomes complicated and serious.

The taking and preserving of a proper history in a simple case of urethritis is just as important as in any other disease, yet how few cases are recorded and tabulated except by the specialists!

A careful history should be taken of the number and date of previous gonorrheal infections, together with duration and complications; also the present condition should be inquired into in detail. It is extraordinary how many stubborn cases one sees with a slight urethral discharge as the only symptom. For numerous reasons it is advisable to investigate the urinary history, including frequency, dysuria, etc., also any symptoms pertaining to past or present diseases of the kidney or bladder.

Every patient with urethral infection should remove sufficient clothing to enable the physician to make a thorough examination.

NAME L. P. ADDRESS DATE

Occupation Laborer Age 20 years.

1st Urethritis Yes. Treat. No previous treatment.

2nd Urethritis Comp.

3rd Urethritis

Diagnosis Acute anterior urethritis cub. 4 days. Duration 2 days.

Meatus Red, congested, ectropion Discb. Gonococci.

Urination: Night No; Day 3 to 4 X; Pain During act

I Turbid
II Clear
III

Sexual Sympts. None

Blood No.

Stricture No.

Prostrate No.

Vesicles No.

Testicles No.

Fig. 161.

The presence of a urethral discharge should be noted and a discharge, if present, examined; also a careful examination of the external genitals must be made. This may reveal an obscure focus of infection which has escaped the attention of both the patient and his physician, if he has previously employed one. The rapid and successful treatment of the individual case depends upon the following:

(1) Early and accurate diagnosis.

(2) Standardization of treatment.

(3) Subsequent treatment based upon the frequent microscopic examination of the discharge.

The cases presented have been selected with the special idea of following this class of infections through simpler forms at first, in order to prepare you to understand the more complicated cases that occur daily in this clinic. The cases are of the usual type that present themselves here for treatment.

CASE I.—Simpler anterior specific urethritis.

It will be seen from the accompanying history that this patient has three simple but cardinal symptoms—*i. e.*, a discharge containing gonococci, painful urination, and a turbid urine in the first glass as shown by the two-glass test. These are sufficient to make a diagnosis.

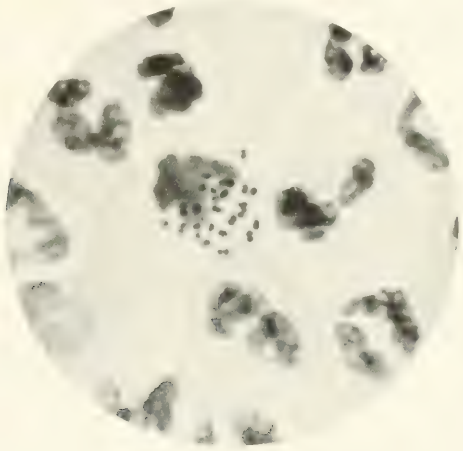


Fig. 162.—Appearance of discharge at the onset of infection. Intracellular gonococci with large numbers of leukocytes present.

Methods of Detecting the Gonococcus.—The gonococcus has peculiar characteristics which enable it to be differentiated from other organisms. It grows best on ascitic fluid agar and the macroscopic appearance of the culture is fairly characteristic. The colonies when grown twenty-four hours at 37° C. appear spheric, resembling dewdrops, are grayish blue and transparent, slightly iridescent, and about 1 mm. in diameter. In gonorrheal pus the prevailing form of the diplococcus is the "coffee bean" or "roll" shape.

The gonococcus is particularly characterized by being found within the protoplasm of the pus-cell and never in the nucleus. Although appearing in thick smears to be within the nucleus, the bacilli are, in reality, on top. This position is less frequent in the early stages, but it is the rule in the stage of excessive purulent inflammation. In the later stages there are fewer leukocytes and the cocci are found in the epithelial cells or often free in groups. In acute and chronic cases the cocci are often extracellular.

In recent gonorrheal infections of the genital mucosa the microscopic demonstration of the gonococcus is not difficult. The many other methods of staining the gonococcus have no advantage over Löffler's methylene-blue in differentiating it from other organisms, as they all take the stains alike. By the addition of a little ammonia to Löffler's methylene-blue the leukocytes, epithelial cells, and cocci are all intensified, and as a consequence the picture is made more vivid.

The only staining method which possesses any certain value for differential diagnosis of the gonococcus, however, is the Gram method. If the smears have been made evenly thin and have been properly stained, the gonococcus in gonorrheal pus and in cultures is always completely and accurately decolorized. In the same manner the gonococcus can be differentiated, particularly from a number of cocci, including some diplococci which occur under normal conditions in the male and female genital tracts. A rapid simplification of the Gram stain is the following:

Six wide-mouthed 4-ounce bottles are numbered consecutively and labeled according to the following ingredients: Bottle 1 contains alcohol-saturated gentian-violet with distilled water in the proportion of 1 part stain to 2 parts water. Bottle 2 contains plain distilled water. Bottle 3, Gram's solution. Bottle 4, absolute methyl-alcohol. Bottle 5, plain distilled water, and Bottle 6, dilute Ziehl-Nielson carbolfuchsin (1 : 10), whose speedy and penetrating staining properties are well known. The elements of the stain differ from the original technic in two essential details, namely, the employment of plain water for the gentian solution in place of anilin-water (this may be used nevertheless), and, most important, the substitution of absolute methyl-alcohol for ethyl-

alcohol as the destaining agent. The reason for this substitution is that the latter acts far more quickly and efficaciously, thereby featuring a desirable time-saving phase.

In staining by the Gram method the slide is dipped into Bottle 1 for from five to ten seconds, with constant stirring, is transferred to Bottle 2 for a few seconds, excess water being shaken off, then to Bottle 3 for five seconds, with constant agitation of slide, thence to Bottle 4, where it takes but a few seconds to destain, especially if stirred, then transferred to Bottle 5 to wash (if it is not yet destained the slide is returned to Bottle 4 again), and lastly to Bottle 6 for a couple of seconds. It is washed off in tap-water. The staining and counterstaining, it will be seen, have been performed in about one minute.

It will be noticed that after staining with gentian-violet the slide is washed in water. According to good authorities, washing the slide with water before destaining is permissible in the employment of the Gram method.

Pathology.—According to Morton, the gonococci are introduced into the urethra usually in uterovaginal secretions. They do not remain upon the free surface of the urethral mucous membrane, but rapidly penetrate between the epithelial cells, and are to be found in the submucous connective tissue. They multiply in colonies, in the interepithelial spaces and upper layers of the submucous connective tissue, and the toxic substances which they produce cause reaction on the part of the tissues, which is characterized by dilatation of the blood-vessels and discharge of serum and leukocytes. The cylindric epithelial cells lining the urethra are loosened by the flow of secretion and are desquamated, forming erosions of the epithelial surface.

An active process of phagocytosis takes place by which the gonococci are taken into the pus-cells, and thus removed from the tissues, and in cases which run a normal course the gonococci have almost entirely disappeared from the mucous connective tissue and deeper layers of the mucous membrane by the end of the second or third week.

When the stage of decline commences the epithelial erosions

begin to undergo repair by being covered with squamous epithelium in many layers.

In normal and ordinary cases the process of getting rid of the gonococci is accomplished in the ascending stage by phagocytosis, and in the stage of decline through desquamation of the epithelial cells, so that in the fifth or sixth weeks, in favorable cases, the gonococci have disappeared entirely from the urethra and the inflammation ceases.

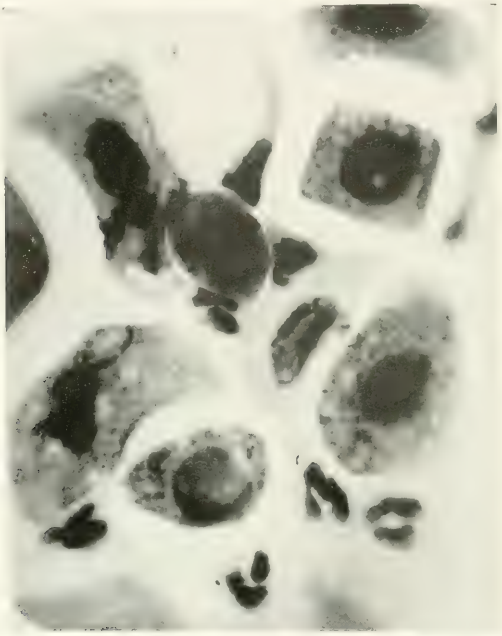


Fig. 163.—Appearance of discharge when repair has taken place, as shown by the large number of epithelial cells, few leukocytes, and no gonococci.

Morgagni's crypts and Littré's glands are also affected by the inflammatory process which occurs within their cavities as well as around them, and the cavities of the glands act as foci of suppuration and incubating places for gonococci for months after the inflammation has ceased on the free surface of the mucous membrane. An infiltration of small round cells, which are derived from a proliferation of the fixed connective-tissue cells and from

leukocytes which have escaped from the capillaries, occurs as part of the process of inflammation, and may be (*a*) superficial or confined to the mucous membrane and its connective-tissue layer immediately underneath, and dipping down and surrounding Morgagni's crypts and Littré's glands, or may be (*b*) the deep form, in which, in addition to affecting the mucous membrane and glands, the small round-celled infiltration involves the deeper submucous tissues, extending into the spongy tissue of the corpus spongiosum in severe cases. The crypts and follicles are usually surrounded by and embedded in the small round-celled infiltration.

The erosions either (*a*) become covered with squamous epithelium in many layers, which offers a barrier to the renewed invasion of the tissues by gonococci, or (*b*) the erosions remain without being covered by squamous epithelium, but become the seat of granulations and occasion a chronic discharge.

The small round-celled infiltration (*a*) disappears by absorption, especially when superficial and confined to the mucous membrane, and the urethra becomes healthy, soft, and flexible, or (*b*) the small round-celled infiltration is not absorbed, especially when deep seated—*i. e.*, involving submucous tissue and cavernous tissue of the corpus spongiosum—but becomes transformed into true fibrous connective tissues called "stricture."

Instruments and Materials

I. *Instruments.*

(1) Irrigating outfit.

(2) Guyon capillary syringe.

Fig. 164.—Guyon capillary syringe.

(3) Large glass syringe with blunt nozzle, holding about 10 c.c.

(4) Set of sounds or flexible bougies.
(5) A suitable clamp for holding the meatus.

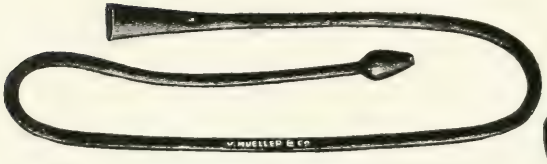


Fig. 165.—Flexible bougie.

Fig. 166.—Urethral clamp.

II. *Materials.*

Three per cent. stock bottle protargol, not to be kept longer than three weeks, in dark-colored bottle.

One per cent. stock bottle nitrate of silver, also kept in dark-colored bottle.

Three dark 1-ounce bottles containing respectively 0.25, 0.5, and 0.75 per cent. nitrate of silver.

Treatment.—Having satisfied myself that I have a specific urethritis to deal with, I proceed as follows:

The patient is instructed to urinate in two glasses (this test is of no value unless the patient has held his urine for at least four hours). In a large majority of acute cases, if seen before the fifth day, the infection has not yet become posterior, as will be seen by the urine glasses: the first will be cloudy with specks, the second clear, showing that the case is one of a simple anterior urethritis.

If the cases are handled according to the following method there will be no further trouble:

The patient is placed on his back (or if one prefers to have him stand there is no objection unless there is an extreme grade of inflammation); 2 to 5 c.c. of a 3 per cent. solution of protargol heated to 100° F. are gently injected into the anterior urethra by means of the glass syringe. Pressure is made at the juncture of

the anterior and posterior urethra to keep any fluid from passing backward. This is especially important in cases of relaxed external sphincters. This solution is held in the anterior urethra three or four minutes by means of a small clamp that gently holds the meatus together. This may be preceded by an anterior irrigation of 1 : 1000 protargol, care being taken to use only a little pressure. After allowing the injection to flow out slowly a loose dressing is placed over the penis to allow for good drainage. Under no consideration is the patient allowed to crowd cotton between the folds of the prepuce to catch the discharge.

The patient is next given a hand injection, either 0.50 per cent. protargol or $\frac{1}{2}$ per cent. albargin, and instructed to use it four or five times a day, care always being taken not to use any force, and to make pressure at the posterior end of the anterior urethra during the injection. For the high-grade local inflammation that is always present, and which is exaggerated by the warm injection, the patient is instructed to immerse the penis in a glass of hot water for fifteen minutes two to four times on the first day, if possible, always using great care to keep the water as hot as possible the whole time. This procedure will rapidly take out the inflammation and permit the continuance of the treatment.

On the second day the discharge is examined and carefully noted, to see if the gonococcus is still present. Occasionally, when the duration of the urethritis is under thirteen hours, one injection is sufficient to drive the gonococci out of the urethra. Whether they are present on the second day or not, however, I continue the treatment for four days, 3 per cent. protargol in the anterior urethra at the office and hot immersions and injections at home. If for any reason on the second or third day there is the slightest suspicion of a hemorrhage, cold 3 per cent. protargol solution is substituted for the hot solution, and the patient is told to reduce his hand injections to once or twice a day, but to continue the hot immersions as previously.

On the third day the discharge is again examined and a careful search is made for the gonococcus. If cocci are absent, the same treatment is continued for another day (four days in succession); on the other hand, if they are still present, the treatment

is continued until the organism is absent and has remained so for four successive days, great care being always taken to discontinue the 3 per cent. protargol entirely if hemorrhage is in the least persistent. If the hemorrhage is at all severe, all local treatment within the urethra is discontinued, but the suspension in hot water is continued.

We now assume one of the following: Either (1) that the gonococcus has disappeared entirely from the urethra, or (2) that

Fig. 167.—Appearance of discharge as evidenced by the so-called "after-catarrh." Discharge shows epithelial cells, large amount of mucus, and absence of leukocytes and gonococci. This case calls for the use of astringents.

it has invaded the deeper layer of the mucosa or glandular tissue and does not appear in the discharge.

Now, provided the organism has been absent for four successive days and the local inflammation has subsided, a 1 per cent. nitrate of silver solution is gently passed into the anterior urethra. With the solution in place the urethra is gently massaged, the same precaution always being used about constricting the

anterior urethra at its junction with the posterior urethra. The 1 per cent. nitrate of silver acts as a harrow; it causes a large amount of desquamation, and in so doing may dislodge any organisms that have invaded the deeper layers of the mucosa.

The patient is instructed to continue his hand injection for two days, at which time he presents himself for another microscopic examination. If on the second day after the 1 per cent. silver nitrate injection the gonococcus again makes its appearance, it is necessary to start from the beginning, treating this acute exacerbation as a new acute attack. On the other hand, if no organisms are present, a well-lubricated bougie (one that just fits into the meatus snugly) is passed the length of the anterior urethra, care being taken not to produce any traumatism. With this in place the urethra is gently massaged. This is followed by a 3 per cent. protargol injection.

The patient is then instructed to use his hand injection for three to four days longer, and at the end of this time, if there are no organisms present, he is given a rest for five days, being instructed to return at the end of the fifth day. If the microscopic examination of the discharge shows no gonococci at this time the patient is instructed to drink some beer; if this does not cause a return of the discharge in thirty-six to forty-eight hours he may be considered well.

In all cases of simple anterior urethritis in which there are no complications the patient is instructed to discontinue the use of alcoholic drinks for one month after his test-drink, as they tend to aggravate a "postgonorrheal catarrh." In a large percentage of cases when you have removed the cause (the gonococcus), all that is necessary is to keep the functions of the body active, and the discharge will cease.

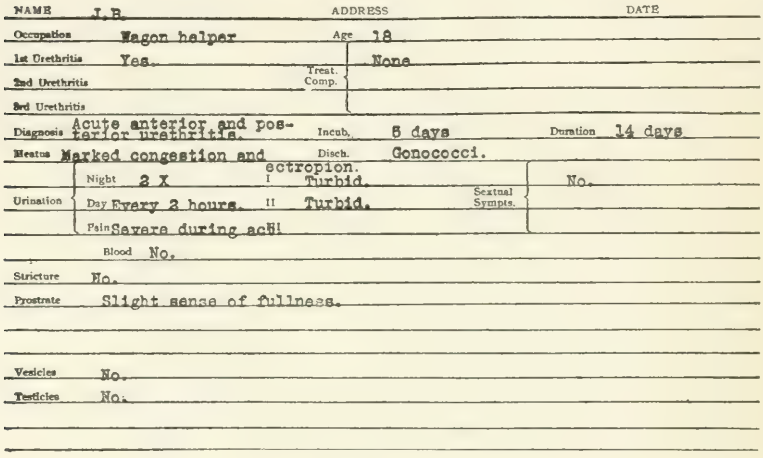
Astringents are to be emphatically condemned, as a discharge that persists in spite of careful dietetic and hygienic care is sure to contain cocci, and suppression of the discharge only tends to lock the gonococci tighter within the urethral mucosa.

In a few exceptional cases, especially after a prolonged course of treatment, a catarrhal condition of Littré's glands, which calls for astringent treatment, may occur.

Case II.—Posterior urethritis.

It will be seen from the accompanying history that this case of posterior urethritis is identical with the preceding except that the urinary frequency is increased, pain and discomfort are more severe, and both urines are turbid, as shown by the two-glass test. These symptoms are typical of simple urethritis totalis and are due to the involvement of the posterior urethra.

Few patients with simple anterior urethritis, if seen early and treated in the above manner, acquire posterior involvement. When the two-glass test shows an involvement of the posterior


NAME J. B. ADDRESS DATE

Occupation Wagon helper Age 18

1st Urethritis Yes. Treat. None

2nd Urethritis Comp.

3rd Urethritis

Diagnosis Acute anterior and posterior urethritis. Incub. 5 days Duration 14 days

Meatus Marked congestion and ectropion. Disch. Gonococci.

Urination: Night 2 X I Turbid. Sextual Sympts. No.

Day Every 2 hours. II Turbid.

Pain Severe during act

Blood No.

Stricture No.

Prostrate Slight sense of fullness.

Vesicles No.

Testicles No.

Fig. 168.

urethra I proceed as follows (always having the patient empty his bladder before treatment): Depending on the severity of the symptoms, 0.25 to 0.75 per cent. nitrate of silver is passed into the posterior urethra by means of the Guyon capillary syringe. If there is the slightest irritability and tenesmus only the weakest solution is used. Following this the anterior urethra is injected with warm 3 per cent. protargol, the same precaution being used not to let it pass posteriorly. The anterior treatment is continued daily with the same limitations as for acute anterior urethritis, but the posterior treatment is not resumed until the third day. Should the irritability and tenesmus increase in severity,

all treatment, both anterior and posterior, is discontinued and the patient is given a saline laxative, hot sitz-baths, and rectal suppositories containing the following:

℞ Extracti belladonnæ }
Extracti opii } ..... āā 0.25 gm. (gr. iv);
Ichthyoli }
Iodoformi } ..... āā 2.50 gm. (gr. xxxviij);
Butyri de cacao ..... q. s.—M.
Fiant suppos. rect. No. x.
Sig.—Insert one every six hours.

On the third day, provided the acute posterior symptoms have all subsided, the prostate is gently massaged and 0.25 to 0.5 per cent. nitrate of silver is injected by the Guyon catheter, followed by the anterior treatment. No matter how slight the posterior infection may be, there is always a corresponding involvement of the prostate, and the posterior infection will not clear up unless the prostate receives attention. In acute cases it is seldom necessary to use stronger solutions than 0.75 per cent. nitrate of silver posteriorly. When the urine clears in the second glass, and the prostate shows no pus microscopically, a bougie is passed the full length of the urethra, but the 1 per cent. nitrate of silver is omitted in the posterior urethra. If this does not produce a recurrence, the beer-test is applied. If the gonococci are still absent and the urine glasses clear, the patient may be considered well. In the event that the gonococci appear again, however, it is necessary to start as from the beginning.

In all cases of acute posterior urethritis it is advisable to put a good, snug-fitting suspensory on the patient—not the ordinary suspensory that simply holds the scrotum together, but one that raises the testicles well up toward the pubes.

Internal Treatment.—Since the time of our forefathers internal treatment of some sort in specific urethritis has always been the custom. From LaFayette's mixture to the more modern capsules of sandal-wood oil the patient has been drugged, and, pray, what for? With the idea that the urine could be made antiseptic.

It is a long way from the gastro-intestinal tract to the end of

the urinary organs, and any remedy must be given in heroic doses to get there, notwithstanding the injurious effects that may be produced upon the stomach and digestion.

We all know that the gonococcus grows best on alkaline blood-serum, consequently by the use of sodium salicylate in 10-grain doses three to four times a day the urine is rendered acid, thereby creating a condition in the urinary tract that inhibits the growth of the gonococcus. Methylene-blue, frequently prescribed by many physicians, clouds the urine-test glasses and is devoid of any therapeutic value.

Diet.—Coffee is permitted, together with a good generous diet that does not contain too much meat. Plenty of water, 8 to 10 glasses a day, should be used when the infection is confined to the anterior urethra.

Alcoholic beverages of any kind should be discontinued. Tobacco may be used with moderation; all sexual excitement should be prohibited.

CLINIC OF DR. JOSEPH C. FRIEDMAN

MICHAEL REESE HOSPITAL

THE DIAGNOSIS AND TREATMENT OF CHRONIC CONSTIPATION

Physiology of the Large Intestine. Main Types of Constipation: (1) Colon Type—(a) Atonic; (b) Spastic. (2) Dyschezia Type. Relationship of Constipation to Auto-intoxication, Neurasthenia, Gastric Secretion, Intestinal Flatulence and Visceroptosis. Complications: Appendicitis, Chronic Colitis, Diverticulitis, Mucous Colitis, and Hirschsprung's Disease. Treatment: Dietetic, Medicinal, and Mechanical.

Physiologic Considerations.—Before we can consider the clinical aspect of our subject it will be necessary to review briefly the present state of our knowledge of the physiology of the large intestine. We know that small quantities of sugar, fat, and coagulable protein and of the products of their digestion reach the cecum, and that most of the absorption of water and nutrient material in the large intestine takes place in the cecum and ascending colon, while but very little change in consistency takes place during the passage through the descending colon, the normal, firm consistency of the stool being finally attained by the absorption of water in the lower part of the sigmoid or so-called pelvic colon, where the feces are retained until the act of defecation occurs. The average rate of passage of feces as determined by *x*-ray examination is as follows: Four and one-half hours to the cecum, six and one-half to the hepatic flexure, nine to the splenic flexure, and eleven hours to the sigmoid. About six hours are required to pass through the lower part of the sigmoid or pelvic colon—*i. e.*, about eighteen hours are required for the passage

from the stomach to the end of the sigmoid, where it remains until the next defecation occurs.

Peristalsis of both stomach and intestines is normally to a great extent independent of the central nervous system, their motor functions depending for the most part on reflexes having their center in the cells of Auerbach's plexus, and to a less extent on stimuli from the cerebral centers. An evidence of the latter is the diarrhea following excitement in some neurasthenic individuals. The taking of food, moreover, is the most powerful stimulus to the motor activity of the colon in man. The progress of a bismuth meal in this portion of the digestive tract is exceedingly slow, and often no appreciable change can be observed after watching an hour. On the other hand, the feces advance considerably immediately following a meal, much more progress being observed during the hour in which dinner is taken than in the previous four hours. Clinically, this fact is verified most frequently in achylia gastrica, where a bowel movement may occur after every meal, and in adhesions around the cecum or pelvic colon, where the pains are apt to occur one to two hours after eating—*i. e.*, when peristalsis is most active in that part of the tract. On the other hand, intestinal movements may under certain conditions be inhibited by nervous influences. Thus, Cannon found that the movements in his cats ceased when they were excited or angry, and stimulation of many sensory nerves may produce the same effect. This is, no doubt, one of the principal factors in the causation of the deficient digestion which often accompanies pain in any situation, and of the reflex constipation of which we shall speak later. The local reflexes which give rise to intestinal movements are produced by mechanical and chemical stimuli, causing contraction to occur above the site of irritation and relaxation below, which combination of proximal contraction and distal relaxation constitutes true peristalsis. The mechanical stimuli are the indigestible and undigested remnants of food, chiefly cellulose, together with a small amount of starch and protein, intestinal bacteria, and digestive juices.

As stated above, the feces remain in the pelvic colon until defecation occurs, the rectum being normally empty in the inter-

vals. As soon as part of the feces which have accumulated in the pelvic colon during twenty-four hours enter the rectum they produce the sensation of fulness which leads to the desire to defecate; the same effect that is produced by a digital examination of the rectum, and for the same reason. The entry of feces into the rectum is the result of active peristalsis of the colon brought about reflexly by various stimuli, the chief of which is the introduction of food into the stomach at breakfast, as emphasized above. Minor stimuli are cold baths, a drink of cold water, smoking a cigar, and many others. The call to defecation having occurred, the act itself is started by the increase in intra-abdominal pressure brought about voluntarily by the simultaneous contraction of the muscles of the abdominal walls and the diaphragm. The levator ani muscles as a result of their normal tone offer a firm resistance to pressure from above, and allow the voluntary muscles of defecation to create the necessary rise in the intra-abdominal pressure. This increase in pressure causes more feces to enter the rectum and the anal canal. As a result of the latter irritation a reflex occurs, causing strong peristaltic contraction of the colon and relaxation of the anal sphincters. In most cases the whole of the large intestine below the splenic flexure is emptied during defecation.

Classification.—We may now return to a consideration of the clinical side of our subject. The best classification of constipation is one according to which part of the two processes which maintain the regular action of the bowels is deranged—viz., the passage of the residue of food from the stomach to the lower end of the pelvic colon; and, second, the emptying of the pelvic colon and descending colon at regular intervals. In the first class the passage through the intestines is delayed while defecation is normal, and in the second class there may be no delay in the arrival of the feces in the pelvic colon, but their final excretion is inadequate, the so-called dyschezia. The two classes of constipation may, of course, exist in the same patient, but in the vast majority of cases one is much more prominent than the other and alone requires treatment. In all cases of chronic constipation an abdominal and rectal examination should be made. If more than

a very small quantity of feces is found in the rectum at any period except immediately before defecation, dyschezia may be diagnosed. On the other hand, if the rectum is almost or quite empty the constipation must be due to delay in the passage through the intestines, and treatment should be directed to this condition.

Let us take up the latter class first. Delay in the passage of feces through the intestines may be due to deficient motor activity of the intestines or to excessive force being required to carry the feces to the pelvic colon. In the majority of cases (apart from organic obstruction) the delay is confined to the large intestine, and more specifically to some point *distal to the hepatic flexure*, this being the point where the intestinal contents begin to be more or less solid, and hence requiring greater force for their propulsion. Deficient motor activity of the intestines may be due to various causes, such as weakness of the musculature first, and second, diminution or inhibition of reflex activity. Weakness of the intestinal musculature may be a congenital defect, when it may occur in several members of a family or result from senile changes. It is probably one of the most frequent causes of the constipation of old people, though defecation is also probably less efficient in old age, as the abdominal, diaphragmatic, and pelvic muscles share in the deterioration. In the constipation of chlorosis, cachexia, and that following prolonged fevers weakness of the colonic musculature is also a prominent factor. The other group of factors producing colon constipation accounts for the larger number of cases, and is concerned with some derangement of the nervous element of peristalsis; either too weak a stimulation of the afferent nerves by colon contents or a depressed condition of the whole nervous system. As an example of too weak a stimulation by the intestinal contents we may cite that class of cases in which insufficient food is taken. For instance, in gastric distress of various origins the patient often diets himself because he thinks that his distress is due to his inability to digest some special article of food. He gives up one thing after another until a severe constipation is added to his other functional or organic trouble. Such a condition is not unusual in neurasthenics. Another example of insufficient stimulation is found in

those very common cases where the diet produces insufficient mechanical and chemical stimuli. This is most frequently due to insufficient cellulose or to cellulose which has been too much softened by cooking, a result of unconscious selection of food by the patient, or of diets prescribed by physicians from which the cellulose has been removed. Diets rich in cellulose and starch probably produce a more abundant intestinal secretion and allow a larger growth of bacteria (which form one-fifth to one-third the weight of dried feces), so that a sufficient mass is present to mechanically stimulate the colon. On the other hand, though a normal amount of proper food is taken, constipation may result from an insufficient bulk due to an unusually active intestinal absorption, the so-called greedy colon. In such cases the amount of stool is, of course, abnormally small compared to the amount of food taken and can be recognized by this means. Another and much overrated cause of insufficient stimulation is lack of exercise. As constipation occurs among those in very active vocations as well as in sedentary, it must be a cause of secondary importance, but is apt to play a rôle where there is a change from active to sedentary life, as when a school-girl takes a position as a stenographer, from which time she dates her disturbance.

In the second group of causes—viz., a depressed condition of the nervous system—we have a large number of cases. It results in atony of the colon, in which, owing to depression of the nervous system, there is a diminished response to the stimuli which normally excite intestinal activity. This group includes the constipation so often present in neurasthenics and in insanity, especially melancholia. Another type of nervous derangement is the inhibitory, among which are classed lead-poisoning, probably due to action of the metal on the sympathetic nerves, stimulation of which inhibit intestinal movements, the temporary constipation often following depressing emotions, particularly likely to result in an exaggeration of the condition in people with a tendency to slight constipation. Cannon's observation of the inhibitory effect of anger on cats, quoted above, explains this group quite readily. The reflex ileus in biliary and renal colic is a manifestation of the same inhibitive function.

In contrast to the atonic types of constipation we have the much less common or spastic form, most often met with in association with the passage of mucus or mucous colitis. These patients have the ordinary atonic type between attacks which may recur for many years, and last with short intermissions for periods varying between a few days and months. Tenesmus is frequently present at such times. The feces, which are hard and dry and often coated with mucus, may be quite flat or narrowed to the diameter of a finger or a lead pencil, but just as often small round scybala are passed. The former more characteristic type of stool is probably produced by an accompanying spasm of the sphincter ani and not by spasm of the colon. During an attack there is a dull ache in the abdomen which often does not amount to actual pain, and occasionally nausea. The pain may be located in the right or left iliac fossa, or sometimes in one and sometimes in the other. The colon may be palpable as a thin, hard, tender cord, and may at times be felt to relax. When the pain is in the right iliac fossa appendicitis may be simulated and forms one group of pseudo-appendicitis cases in which appendectomy gives no permanent relief. Spastic constipation is probably the result of spasm induced reflexly by the presence of an irritant in the colon of a patient with an abnormally excitable nervous system. The nervous factor is shown by the neurotic temperament of all patients affected with the condition, and the frequent history of worry ar overwork immediately preceding an attack, as well as by the good effects of belladonna, which diminishes the activity of the motor nerves to the intestines. The irritant which gives rise to the exaggerated reflex is probably in most cases hard feces, the retention of which is due to the ordinary neurasthenic constipation which is generally present in the intervals between the attacks.

The following is an example of this class: George S., thirty-three years of age, married, for three years has had a pain to the left of the umbilicus, not constant in situation, dull and not radiating. It occurs in attacks with free intervals, with no relations to meals. Pressure relieves the pain. He can feel a sausage-shaped tumor at the point of pain. He has been constipated

for many years, but can see no relation between the attacks of pain and the constipation. Physical examination was negative; stools normal. Fluoroscopic examination by barium meal and

Fig. 169.—Spastic descending colon in a case of enterospasm.

enema reveals a markedly spastic colon, immediately after the introduction of the enema assuming the condition shown in Fig. 169.

Another etiologic group of constipation is that due to excessive force required to carry the feces to the pelvic colon. These cases are comparatively rare and include those in which the feces are excessively dry, either from insufficient water being drunk or from excessive water in urine and sweat. In diabetes mellitus and insipidus the constipation present is due to the latter factor. The constipation due to fecal impaction, to stricture, and to new growths belongs in this class, though, of course, in all these we not infrequently have alternating constipation and diarrhea.

Kinking of the intestine is generally supposed to be the cause of constipation so frequently present in visceroptosis, but much more frequently we have a normal passage of feces through the colon, the constipation belonging to the class of insufficient defecation or dyschezia due to weakness of the abdominal muscles.

Lane has described a type of constipation which he believes to be quite frequent, and for which he has described various operations, a type due to kinks and adhesions in the terminal ileum, cecum, and ascending colon. His method has found numerous imitators, so that it is worth while to consider his evidence. That such adhesions are frequently found is beyond question, and not only in constipated individuals but also in those with no such history. They are sometimes found around the pylorus and gall-bladder, but more frequently around the ascending colon and splenic flexure. But the most positive evidence against his theory is the fact that fluoroscopically, even in the severest cases of constipation, we rarely find any prolonged stagnation of intestinal contents before the middle of the transverse colon is reached, so that it could not possibly have been caused by kinks or adhesions proximal to the hepatic flexure.

The second great group of constipation is that in which there is an inability to defecate completely, or dyschezia. It is characterized by the presence of more or less considerable quantities of feces in the rectum whenever an examination is made, even immediately after defecation. It is due to one of two factors, either habitual disregard of the call to defecation or to inefficiency of the voluntary muscles which normally take part in defecation.

The habitual neglect of the call to defecation leads to the

accumulation of feces in the pelvic colon and rectum, which gradually become more and more distended, so that the tone and contractility of their musculature is impaired. This disregard is a well-known condition, and may be due to laziness, prudery, lack of time, etc. The second group of dyschezia cases includes those in which the muscles of defecation are inefficient, including those of the abdominal wall, the pelvic floor, and the diaphragm. As stated above, the constipation in visceroptosis is most frequently of this type; only rarely is it combined with the colonic type of atonic or spastic constipation. From the physiology of defecation described above we can readily understand how such weakness interferes with the complete emptying of the rectum, so that both visceroptosis and the constipation are the results of the same cause—viz., weakness of the abdominal muscles. The truth of this statement can readily be demonstrated by observing the relief from the constipation and from the symptoms due to visceroptosis by strengthening the muscles by means of exercises and massage, and by supporting them in severe cases by means of an abdominal belt. Weakening of the pelvic floor in parturition and impairment of the action of the diaphragm, as in emphysema, may also have the same effect.

Strictures of the rectum and tumors of the rectum may also cause dyschezia, and the spasm of the sphincter ani due to fissure may interfere with the defecation.

To sum up, then, we have two main types of constipation: first, that in which the passage through the colon is delayed or the so-called colon type. The delay is practically always in the descending colon, and is due either to insufficient stimulus or inability of the colon to respond to that stimulus (atonic type), less frequently to overresponse (spastic constipation); second, that in which the act of defecation is incomplete (dyschezia), in which weakness of the abdominal muscles is the most frequent causative factor.

Symptomatology.—The symptoms of constipation, if we are to believe writers on that subject, are innumerable, and the strength of the evidence in support of them is in inverse proportion to their number. We all know that some individuals may go

weeks without any bowel movement and suffer no ill effects, and, on the other hand, patients not infrequently give heart-rending pictures of their sufferings if the act is delayed a few hours. Which is true? The greatest stress from time immemorial, and more so since Bouchard's work, has been laid on auto-intoxication. Bouchard's work on the increased toxicity of the urine has been completely discredited. No one has shown that the products of ordinary bacterial decomposition are toxic when absorbed from the intestine, or that they are absorbed in increased amount in constipation. Certainly indicanuria is no measure of bacterial decomposition in the intestines. The disagreeable odor of the breath in constipation is due to decomposition occurring in the mouth, owing to insufficient cleanliness, from pyorrhea, or from tonsillar plugs, and not to volatile organic poisons excreted by the lungs. In spite of the fact that auto-intoxication from stasis in the large intestine has never been satisfactorily demonstrated, it is probable that various toxic effects may be produced, perhaps most marked on any organs already diseased. Many of the minor symptoms are not, however, toxic, but are produced reflexly by the irritation of the mucous membrane of the colon and especially of the rectum by retained feces. Thus the headache which disappears a few minutes after the bowels have moved must be of this character. This class of symptoms, like the toxic effects, depends upon the functional condition of the nervous system, as it is only the irritable nervous system of neurotic individuals which is likely to be seriously upset by this condition.

The *local effects* of an accumulation of hard feces are well known—*e. g.*, hemorrhoids and fissure. Less well known is pruritus ani, and in this condition, in children as well as in adults, a rectal examination should be made to see if the evacuation has been incomplete. Pressure on the sacral plexus may produce pain in the sacrococcygeal region, along the sciatic, or in the hip-joint. Other disturbances of the nervous system, such as mental fatigue, insomnia, and, still further, neurasthenia and hypochondriasis, are always given a prominent place in the symptomatology. Neurasthenics are certainly worse when constipated. Whether this is the result of the problematic auto-intoxication

acting on a subnormal nervous system or simply excessive introspection is a point I am unable to answer. My belief is that the neurasthenia is, as already stated, one of the causes of atonic constipation, and that the constipation affects the neurasthenia unfavorably either through a mild auto-intoxication acting on a depressed nervous system or, reflexly, by irritating the nerve-endings in the rectum, or, most probably, simply psychically through fear.

The question of the relation of constipation to gastric secretion is also unanswered. We find not infrequently the association of hyperacidity and constipation, though in what sequence we do not know. It may be that the very bland, unirritating diet taken by patients with postprandial gastric distress and the consequent insufficient residue may be the cause of the constipation, or that both are of the same nervous origin due to over-irritable nerves. Figs. 170 and 171 show this connection. The patient is a young married woman, twenty-seven years of age, who for three weeks has had headache, heartburn, and nausea. She has some pain in the epigastrium, relieved by food, is occasionally awakened at night by the same pain, and has been constipated for many years. She had a similar attack three years ago following a nervous disturbance. A tonsillectomy was done seven and a half years ago. Physical examination is negative. A fractional meal shows a normal secretion curve, the maximum total acidity being 42, and the motility being slightly impaired. There was no blood in the stomach contents or stool. The *x*-ray of the stomach shows an incisura on the lesser curvature near the pylorus. This incisura remained after four days of vigorous atropin medication. Here, too, the gastric motility was slightly impaired. The *x*-ray of the large intestine shows a spastic colon without, however, any colon constipation, the barium reaching the pelvic colon in fourteen hours, but a typical dyschezia, as the barium mixture remained there for three days without change until an enema was given. This is pictured in Fig. 171. The problem involved is as follows: Is this a prepyloric ulcer with an incisura with a chance coincident constipation, or is it a constipation with a reflex pylorospasm and an incisura? The symp-

toms and clinical findings would be the same in either case. There are those who believe that this symptom-complex invariably is due to a pyloric or a parapyloric ulcer, while others equally

Fig. 170.—Arrow points to incisura.

positively assert that pylorospasm and incisura may result from reflex disturbances elsewhere in the gastro-intestinal tract. Be that as it may, we are, in the present state of our knowledge, bound to consider the constipation in our treatment.

What is the relation of constipation to intestinal flatulence? There are three possibilities: either there is excessive production of gas, or there is deficient absorption, or the same amount pro-

Fig. 171.—Barium in pelvic colon seventy-two hours after ingestion.

duces an abnormal discomfort. Excessive production generally arises from carbohydrate decomposition which is not a constant accompaniment of constipation, or from excessive swallowing of air which is not infrequent in gastro-intestinal atony, or the

feeling of fulness may be due to the same cause as in gastric atony—viz., atony of the colon musculature—or there may be retention of gas with the feces as a result of the sluggish action of the intestines. The consequences of all are the same—a feeling of fulness, occasional palpitation due to gas in the splenic flexure, and relief by passing flatus.

Associated Pathologic Conditions.—The cause of the very frequent association of constipation with visceroptosis has already been explained as due to the weakness of the abdominal muscles. The dropping of the viscera results in a pull on the peritoneal folds and a constant slight irritation of the sensory nerves of the peritoneum, with a vague feeling of abdominal discomfort often described as weight or pressure. In the case of the stomach the discomfort is aggravated by increasing its weight, the quantity of the food only being of importance. The discomfort improves at once on lying down or by pressing upward the lower part of the abdomen by the hands, but is increased by long standing and also by mental fatigue or excitement. The relief can be rendered permanent by using an abdominal belt or by strengthening the abdominal muscles by exercise and massage. If, on the other hand, the constipation which is almost invariably present is alone treated, the abdominal discomfort remains unaltered. Lane believes that the weight of the feces accumulating in all parts of the large intestine in constipation causes the cecum to become dilated and elongated. *x*-Ray examination has shown us, however, that stasis in the cecum is extremely rare and, therefore, cannot account for so common a condition as coloptosis.

It has also been claimed that at times attacks of asthma are brought about by constipation. To bring this fact in line with modern theories we would have to say that there is excessive absorption of foreign proteins perhaps by excessive bacterial activity (of which there is no proof whatsoever), and that as a result of this a state of hypersensitization results. Be that as it may, a free bowel movement occasionally relieves an asthmatic attack.

It has been claimed that because of the proximity of the flexures of the colon to the kidneys infection of the renal pelvis

may occur by the direct passage of Bacillus coli communis from the intestines in fecal stagnation. How frequently this is compared to the hematogenous and ureteral routes is not known, but it is probable that it does occur. Constipation is frequently a factor in nocturnal enuresis in children by direct irritation of the neck of the bladder.

Fecal tumor and fecal obstruction are rare and generally easily recognizable conditions.

An interesting complication is simple catarrhal colitis. This is characterized by the presence of fairly large masses of mucus with the hard scybala constituting the stool and accompanied by a feeling of abdominal discomfort. It is generally explained as due to the irritation from the intestinal stasis, but it has always seemed to me to be due more to the treatment of the constipation by coarse diet, cathartics, and massive enemas than to the primary condition. At any rate, a non-irritating diet and non-irritating enemas are quite efficacious in the treatment. A condition which has recently been mentioned quite frequently in the literature is *diverticulitis of the colon.* One plausible theory of the origin of diverticula is as a result of constipation which is so frequently present in the history of these patients. They are situated most frequently in the position in which accumulation of feces occurs, namely, below the middle of the descending colon. They are quite rare before the age of forty. Their age distribution is probably due to the atrophy of the muscular layer of the colon which occurs in old age, the pressure from within thus producing diverticula more readily than in early life. They generally of themselves give rise to no symptoms except when perisigmoiditis results. The latter condition may also result from extension of infection from simple stercoral ulcers.

Chronic constipation has been regarded as an important cause of appendicitis in spite of the fact that the latter is more common in youth than in old age, while the former is not. I think this theory was being quite generally discarded even before the *x*-ray had shown that fecal stasis in the cecum is a rare condition and, therefore, could not begin to account for any considerable proportion of acute appendicitis cases.

There are two more conditions of considerable interest related to constipation. The first is *Hirschsprung's disease* or *megacolon*. There is in these cases always a history of constipation dating from early life, at times with attacks of diarrhea, and finally with a complete obstruction, with abdominal distention, in which the outline of the distended colon can be generally clearly seen. Pathologically, the lower limit of the dilatation is almost invariably situated in the last 3 inches of the pelvic colon, with, of course, great distention above, accompanied by muscular atrophy. A very plausible explanation is that of primary fecal obstruction in the rectum followed by extreme dilatation and hypertrophy of the proximal colon, and finally obstruction by a kinking of the elongated colon in the pelvis. Treatment based on this theory has been the most successful outside of surgical interference. The most important point is to keep the colon as far as possible free from distention with gas and feces by enemata, irrigations, and massage, or, if necessary, to keep a rectal tube permanently in place for the passage of flatus and for irrigation. If medical means fail, as they will in long-standing cases, surgery is, of course, indicated.

The final complication of constipation of which I wish to speak is *mucous colitis*. This condition is practically the same as that mentioned in the etiology as spastic constipation plus the passage of large masses of mucus during the acute attacks. The constipation apart from the attacks is generally of the atonic variety found in neurasthenics. The attacks are often brought on by depressing emotions. They may come on at long intervals or without intermission. During an attack pain is present, dull and aching or colicky. The pain is situated most frequently in the left flank and iliac fossa and in the right iliac fossa. Here, of course, the resemblance to catarrhal appendicitis is very close and most puzzling at times. The mucus is excreted as membranous shreds or casts of the colon, often described by the patient as tapeworms. They may be transparent as ordinary mucus or opaque like fibrin, either because they are covered with desquamated epithelial cells and leukocytes or because the mucus

has undergone coagulation. In some cases the mucus is found only after irrigating the colon.

The diagnosis of chronic appendicitis is often made in these cases, though true appendictis is an infrequent accompaniment. Visceroptosis is frequently present not as a direct cause, but indirectly because of the associated constipation, which is the chief predisposing factor in an individual with an abnormal nervous system. The irritation of the retained feces in such patients may result in simple enterospasm or spastic constipation, or in a motor plus a secretory neurosis or mucous colitis.

To sum up, then, the constitutional or general effects of constipation, such as auto-intoxication, may be facts, but have no scientific basis to support them at the present time. Reflex symptoms of the nervous system and of the stomach are quite probably local symptoms due to pressure and to irritation of the large intestine, and are a not infrequent result of constipation.

If we bear in mind the classification given above, the treatment of constipation becomes at once a simpler and yet more complicated problem than in the past.

Prophylaxis.—First, as to the prophylaxis: The old rules apply here in full force. From earliest childhood an attempt should be made to open the bowels at the same hour every day. Bearing in mind the effect of the ingestion of food, the time should be after a meal, preferably breakfast. A call to defecation at any other time of the day should never be neglected, as the rectum rapidly becomes insensitive and dyschezia results. Sufficient time should be spent in the act, as a single effort is generally not sufficient to empty the whole descending colon, which then may result in cumulative constipation, in which there is a gradual collection of retained feces though there is a daily evacuation.

Dietetic Treatment.—In the actual treatment of established constipation diet assumes the first place. Thus in all cases of colon constipation in which the motor activity of the intestines is deficient, whether this is due to primary muscular defect or deficient reflex action or from insufficient bulk of feces, a change of diet is beneficial. Since cellulose is the best stimulant of intestinal peristalsis we have, it is, of course, added in the form of

fruits and vegetables. The chief chemical stimulants are the sugars and organic acids, both those present in vegetable food and the products of bacterial decomposition of carbohydrates in the intestines. Fats, fatty acids, and soaps are less important. These facts are common knowledge, and a diet containing whole-wheat bread, large amounts of raw and cooked vegetables, fruits (except bananas), honey, etc., is indiscriminately prescribed. What is not so well known, however, is that this diet is only of value in the atonic constipation of the colon. In the other varieties—namely, the spastic variety of colon constipation and in dyschesia—such a diet is useless or worse. In emaciated people olive oil is often of benefit. Mineral oil fails more often than it helps. Agar-agar is of value to increase the bulk of the stool. It is always of importance to see that sufficient water is drunk. In spastic constipation and very frequently in thin, visceroptotic individuals (especially women) leading a sedentary life, even where the *x*-ray shows no spasm, a coarse diet suitable to a laboring man is of no benefit, and, indeed, often leads to severe abdominal distress. In such individuals a bland diet, in which all the food is very thoroughly cooked and softened, with plenty of *strained* vegetables and fruits to produce a mild stimulation, combined with bromids, if necessary, is far more efficacious. It cannot be too greatly emphasized that in this class of individuals, whether with colon constipation or dyschezia, the usual coarse diet *overstimulates* and increases the constipation, besides tending to produce colitis.

Medicinal Treatment.—Purgatives, of course, are avoided if possible, but many people take the mild cathartics continuously for decades without any harm resulting, so that one doubts if they do more harm than the usual coarse diet. They are directly indicated in the constipation accompanying acute infections, and especially in senile constipation one is driven to their use in the end. In some cases of colon constipation where non-medicinal treatment proves insufficient they must also be used. In cumulative constipation an occasional purge is of benefit. As to the choice of cathartic, probably cascara, which acts both on the small and large intestine, is most frequently used. It may be

given once nightly or three times daily in smaller doses before meals. In senile constipation the alternation of cascara, aloes, salts, and enemas in weekly periods is perhaps the best way of avoiding too great habituation to a single drug.

In the occasional cases of greedy colon, where it is desirable to increase the bulk of feces, agar-agar or mineral oil may be used, but, as a rule, the milder cases are more rationally treated by increasing the cellulose in the food.

Enemas are the treatment par excellence in cases of dyschezia where the indication is to keep the rectum and the pelvic colon empty, so that they may in time regain their normal tone. To give such patients purgatives is simply to hurry the feces too rapidly through the small and large intestine, and to leave the rectum uninfluenced, as the vegetable cathartics have very little effect on this part of the intestinal tract. Even in the most obstinate cases the ultimate result of the treatment is often most satisfactory, although the enemas may have to be given regularly for a year or more before the rectum and pelvic colon return to their normal condition. The use of enemas should be discontinued as soon as the power to empty the bowels completely without artificial aid has returned. In slight cases a glycerin suppository may be used. In more pronounced cases the olive or cotton-seed oil enema, introduced at night through a rectal tube and retained until the next morning, is the most frequently employed: 4 to 10 ounces, depending on the need of the case, slightly warmed and slowly poured in, in recumbent posture, are used, and in properly selected cases are extremely effective.

Mechanical Treatment.—In cases of simple atonic colon constipation and of dyschezia due to weak abdominal muscles, exercise, massage, and Swedish gymnastics are of value. The Swedish movements are those affecting the abdominal muscles, and include raising from the reclining to the sitting posture, bending the thighs to a right angle with the trunk while reclining, raising on the toes and squatting, twisting the trunk while standing, and other simple calisthenic movements. In the obese and in visceroptosis they should be done morning and evening, gradually increasing the periods.

The treatment of non-obstructive chronic constipation by operation according to Lane's methods has already been touched upon and the objections thereto cited. To do a colectomy in a case of dyschezia and leave untouched the pelvic colon and rectum, the only diseased parts, is manifestly absurd, and, indeed, it is doubtful if such a heroic remedy, with a mortality of over 20 per cent., could ever gain a wide popularity. The treatment of constipation in visceroptosis has already been touched upon. If dyschezia is present alone, enemas should be used; if atonic or spastic colon constipation is present, the appropriate diet should be added. But the weakness of the abdominal muscles requires special treatment. Here Swedish movements and massage are in order. Furthermore, a well-fitting abdominal belt is of the greatest importance. To be of any value it must be laced in front, be applied lying down, and be drawn tight below and more loosely in the upper half of the abdomen.

The treatment of the neurasthenia which is so frequently at the bottom of so many cases of constipation of all varieties is, of course, according to the usual rules, and, finally, it must be repeated that in all cases of spastic constipation a sedative and not a stimulating treatment is required. This applies to simple spastic constipation as well as to membranous colitis. The diet is balanced, as described above, bland, with considerable fat (except in the obese). Bromids and atropin are in order, not cathartics; while in colitis, irrigation of the colon with warm normal salt solution two or three times weekly is the only topical application permissible. Large amounts of water (3 or 4 quarts) may be used at each treatment, but only enough allowed to run in at a time to produce a slight feeling of distention, when the funnel attached to the rectal tube is immediately lowered and the whole allowed to flow out before more is introduced.

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